Performance on Creative and Routine Tasks: The Role of Context

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Contents

Deutsche Zusammenfassung

Diese Dissertation setzt sich mit dem Verhalten während und nach der Ausführung routinemäßiger und kreativer Aufgaben in unterschiedlichen Kontexten auseinander. Während die Forschung zu Routineaufgaben in der experimentellen Wirtschaftsforschung sehr weit fortgeschritten ist, gibt es kaum Studien zum Verhalten bei kreativen Aufgaben. Ein Grund hierfür mag sein, dass sich die Wirtschaftswissenschaft im Allgemeinen mehr für das finale Ergebnis, welches aus einem kreativen Schaffensprozess resultiert fokussiert, als auf die dahinterliegenden innovativen Prozessen und Leistungen. Ein weiterer Grund könnte es sein, dass traditionelle Forschungsmethoden, wie empirische Studien im Bereich der Kreativitätsforschung, nur bedingt einsetzbar sind.

Der Prozess des kreativen Denkens an sich ist jedoch grundsätzlich von immenser Bedeutung für das Entstehen von Innovation und verdient daher mehr wissenschaftliche Aufmerksamkeit. In der Psychologie wird Kreativität schon seit langem anhand von Feld- und Laborexperimenten erforscht. Feldexperimente bieten dabei zunächst eine hohe externe Validität, sind jedoch andererseits sehr kostspielig und benötigen meist nachhaltige Kooperationen zwischen Privatfirmen und akademischen Einrichtungen. Laborexperimente hingegen stellen eine erfolgversprechende Alternative zu Feldexperimenten dar. Obwohl diese im Vergleich zu Feldexperimenten eine geringere externe Validität aufweisen, ermöglichen sie es, aufgrund der größeren Kontrolle, welche der Forscher über die Daten hat, effizient kausale Zusammenhänge zu untersuchen.

Aufgrund dessen verwende ich in meine Arbeit Laborexperimente, um zu untersuchen, wie Menschen während und nach der Arbeit an routinemäßigen und kreativen Aufgaben auf verschiedene Umgebungen reagieren. Hierbei ist jedoch zu beachten, dass bisher routinemäßige und kreative Aufgaben in der Regel getrennt voneinander erforscht wurden. Um kreative Leistungen jedoch umfassend zu erforschen, ist ein direkter Vergleich dieser Leistungen mit routinemäßigen Leistungen vonnöten, um glaubwürdige Rückschlüsse zur Wirksamkeit von Anreizsystemen ziehen zu können und somit deren Relevanz auch für kreative nachzuweisen.

Die Arbeit ist wie folgend aufgebaut: Nachdem in der Einleitung die Relevanz der Fragestellung dargelegt wurde, wird im zweiten Kapitel untersucht, ob die Höhe der Anstrengungen und die Art der Aufgabe, Kooperation in kleinen Gruppen beeinflusst. Bisherige Forschungsansätze haben gezeigt, dass Individuen dazu neigen Dingen, die sie bereits besitzen eine höhere Wertschät-

zung entgegenbringen als wenn sich diese noch nicht in ihrem Besitz befinden würden. Zudem neigen Individuen dazu Endowments überzubewerten, wenn sie hart dafür gearbeitet haben. Insofern wird erwartet, dass wenn die Experimentteilnehmer größeren Aufwand ausüben, sie sich egoistischer verhalten und ihre Kooperationsbereitschaft im Public Goods Experiment zurückgeht. Darüber hinaus hat die Forschung gezeigt, dass Individuen dazu tendieren, selbst geschaffene Dinge und Leistungen überzubewerten. Aufgrund dessen erwartete ich, dass Experimentteilnehmer dem aus einer kreativen Ausgabe resultierenden Gewinn eine höhere Wertschätzung entgegenbringen. Dies könnte unter anderem dazu führen, dass Individuen zögern zusammenzuarbeiten, da der eventuelle Verlust ihres Endowments zum einen schmerzhafter wäre und zum anderen zudem das Risiko im Public Goods Game besteht, dass die anderen Gruppenmitglieder sich nicht kooperativ verhalten.

Das Ergebnis des Experiments zeigt, dass weder Bemühungsgrad noch Bemühungstyp einen Einfluss auf die Kooperationsbereitschaft im Public Goods Game zu haben scheint. Wenn es um soziale Verhaltensweisen geht, wie z. B. die Zusammenarbeit in kleinen Gruppen, scheinen sich die Individuen stärker auf ihre bisherigen Gruppenerfahrungen, ihre soziale Wertorientierungen und Persönlichkeit zu verlassen. Eine mangelnde Kooperation in einer Gruppe, sollte somit eher den individuellen Merkmalen zugeschrieben werden, als den individuellen Bemühungen der Gruppenmitglieder. Übertragen auf die Mitarbeiterauswahl im Unternehmen bedeutet dies, dass insbesondere die individuellen Merkmale und Erfahrungen von Mitarbeitern wie zum Beispiel, ob ein Bewerber bisherige Erfahrung in der Gruppenarbeit hat und wie stark das individuelle prosoziale Verhalten ausgeprägt ist, bei der Auswahl berücksichtigt werden sollten.

In Kapitel 3 wird untersucht, wie unterschiedliche Konkurrenzgrade routinemäßige und kreative Leistung beeinflussen. Bei Routineaufgaben sind Aufwand und Output eng miteinander verknüpft. Im Gegensatz dazu sind kreative Aufgaben ungewisser und die Leistung nicht nur von der individuellen Leistungsbereitschaft abhängig, sondern auch vom Talenten oder den vorhandenen Möglichkeiten. Daher erwiesen sich Wettbewerbsanreize änlich wie finanzielle Anreize als wenig zielführend bei der Verbesserung der Kreativität. Um den Stand der Forschung zu diesen Themen voranzubringen, wurde ein Experiment entwickelt anhand dessen der Effekt welcher ein schwacher und ein starken Wettbewerb auf die routinemäßige und kreative Leistung hat zu untersuchen. Darüber hinaus wurde die Auswirkung eines Leistungsfeedbacks in Form eines Rankings während des Arbeitsprozesses auf die durchschnittliche Leistung der

Experiementteilnehmer untersucht.

In Übereinstimmung mit der vorherigen Literatur zeigen die Ergebnisse, dass ein geringer Wettbewerb die routinemäßige, aber nicht die kreative Leistung verbessert. Ein starker Wettbewerb steigert jedoch weder die durchschnittliche Leistung bei routinemäßigen noch bei kreativen Aufgaben. Darüber hinaus scheint die Bereitstellung von Feedback vor dem Abschluss der Aufgabe bei kreativen Aufgaben einen negativen Einfluss auf die Leistung zu haben. Männer und Frauen scheinen zudem unterschiedlich auf eine starke Wettbewerbssituation zu reagieren. Während Männer in einer Situation mit starkem Wettbewerb eine signifikant höhere Leistung bei routinemäßigen Aufgaben erbringen als in einer Situation ohne Wettbewerb, kann dies für Frauen nicht beobachtet werden. Die Ergebnisse deuten darauf hin, dass Führungskräfte niedrige Wettbewerbsanreize nutzen können, um Routineleistungen zu verbessern. Allerdings ist eine hohe Wettbewerbsanreize nicht förderlich für routinemäßige Leistung. Weder der Einsatz von niedrigeren noch von hohen Wettbewerbsanreizen fördert kreative Leistung. Zudem scheint ein Feedback zum Ranking vor Beendigung der Aufgaben demotivierend zu wirken und somit die durchschnittliche Leistung zu verringern. Bei der Verwendung von Wettbewerbsanreizen, sollte somit die Bereitstellung von Leistungsfeedback vor Ende des Wettbewerbs vermieden werden.

Im vierten Kapitel wird der Effekte von niedrigen und hohen Einschränkungen auf routinemäßige und kreative Aufgaben untersucht. Die traditionelle Auffassung von kreativem Denken ist, dass es nicht eingeschränkt werden sollte. Kreative und Schöpfer brauchen die Freiheit, neue Ideen ohne äußere Einmischung zu erforschen. Im Gegensatz dazu deuten jüngste theoretische Beiträge in der Literatur darauf hin, dass Beschränkungen jedoch auch motivierend wirken können, indem sie die Aufgabe herausfordernder gestalten. Diese These wurde jedoch noch kaum empirisch überprüft. In diesem Kapitel der Dissertation wird ein ökonomisches Experiment dargestellt, bei dem niedrige und hohe Qualitätseinschränkungen für routinemäßige und kreative Aufgaben implementiert wurden. Hierzu wurden die Experimentteilnehmer aufgefordert Lösungen bereitzustellen, welche jedoch nur entlohnt wurden, wenn ein spezifischer Schwellenwert erreicht wurde.

Entsprechend der konventionellen Sichtweise nahm, sowohl die routinemäßige als auch die kreative Leistung schon bei einer sehr geringen Einschränkung ab. Die weiteren Analysen zeigen jedoch, dass sich die Experimentteilnehmer nach der ersten Phase an die Einschränkungen anzupassen zu scheinen. Be-

trachtet man die Gesamtleistung wird zudem deutlich, dass Experimentteilnehmer ohne Einschränkungen mehr qualitativ hochwertigere Lösungen produzieren als die Experimentteilnehmer welche einer Einschränkung unterliegen. Dies erstaunt, da die letzteren gebeten wurden, nur qualitativ hochwertige Lösungen zu produzieren. Die Konzentration auf die Produktion von Loesungen mit hoher Qualitaet, im Gegensatz zu Loesungen mit niedriger Qualitaet, spart Zeit. Dieses Ergebnis zeigt, dass einige Experiementteilnehmer niedrige Qualitätslösungen verwendet haben, um komplexere und qualitativ hochwertigere Lösungen aufzubauen. Das Forschungsergebnisse deuten darauf hin, dass wenn Qualitätseinschränkungen genutzt werden, z.B. zur Entwicklung eines qualitativ höherwertigen Gutes, mit einer gewissen Zeit zu kalkulieren ist bis sich die Mitarbeiter an diese gewöhnt haben und ihre Leistung der vor der Einführung der Restriktion entspricht. Dennoch können Einschränkungen nützlich sein, insbesondere dann, wenn das Ziel darin besteht, eine einzige hochwertige kreative Lösung zu finden.

Im fünften Kapitel untersuche ich die Rolle der domain-spezifischen Fähigkeiten für kreative Leistung unter Einschränkungen. Im Allgemeinen ist es bekannt, dass eine Person eine gegebene kreative Aufgabe leichter lösen kann, wenn sie spezifische Kenntnisse hat. Allerdings hat bisher keine Forschung die Rolle der aufgabenbezogenen Fähigkeiten untersucht, wenn Schöpfer Einschränkungen gegenüberstehen. In diesem Papier wir argumentiert, dass abhängig vom Qualifikationsniveau, Einschränkungen positive oder negative Auswirkungen auf die kreative Leistung haben können. Auf der einen Seite können die Zwänge einen negativen Effekt, d. h. die schrittweise Entwicklung oder den Aufbau kreativer Ideen verhindern, andererseits können Einschränkungen den Fokus auf qualitativ hochwertige Lösungen ermöglichen und damit die kreative Leistung steigern. Um den Effekt von Einschränkungen auf die spezifische aufgabenbezogenen Fähigkeiten zu untersuchen, wurde ein Laborexperiment entworfen, bei welchem Einschränkungen von außen auferlegt wurden. Die Probanden wurden zudem dazu aufgefordert, eine Selbstbewertung ihrer aufgabenbezogenen Fähigkeiten abzugeben.

Die Ergebnisse zeigen, dass Einschränkungen die kreative Leistung Hochqualifizierter erhöhen. Jedoch verringern die gleichen Einschränkungen die Leistung von weniger Qualifizierten. Der Hauptgrund hierfür mag darin liegen, dass gering qualifizierte Kreativarbeiter auf ihre eigenen Kreationen aufbauen und somit nach und nach die Komplexität ihrer Lösungen verbessern. Beschränkungen scheinen dabei diesen Prozess zu stören. Hochqualifizierte benötigen hingegen keinen Lernprozess und sind somit in der die durch die Ein-

schränkung bedingte Hürde leichter zu überwinden. Die Implikationen dieses Experiments deuten darauf hin, dass Einschränkungen verwendet werden können, um hochqualifizierten Mitarbeitern dazu anzuspornen, sich auf wertvollere kreative Lösungen zu konzentrieren. Für gering qualifizierte Arbeitskräfte sollten jedoch keine Qualitätseinschränkungen verwendet werden. Für sie ist es vorteilhafter, niedrige Qualitätslösungen zu belohnen, um höhere kreative Potenziale zu ermöglichen. Mit anderen Worten: Erstmaliges Versagen von weniger Qualifizierten sollte nicht sanktioniert, sondern toleriert werden.

Ich habe in dieser Dissertation untersucht, inwieweit unterschiedliche Kontexte die Leistungsfähigkeit bei routinemäßigen und kreativen Aufgaben beeinflussen sowie die Kooperationsbereitschaft im Anschluss an diese Aufgaben erforscht. Im Allgemeinen unterscheiden sich routinemäßige Aufgaben konzeptionell von kreativen Aufgaben. Der wesentliche Unterschied besteht darin dass, im Gegensatz zu Routine-Aufgaben, kreative Aufgaben in der Regel intrinsisch motivierend sind. Daher können diese Aufgaben oft nicht durch Geldmittel gleichermaßen angeregt werden. Kreativität und Innovationen sind zudem komplexe Phänomene, die durch mehrere Faktoren beeinflusst werden, die oft nicht von Menschen kontrolliert werden können. Wirtschaftswissenschaftler haben erkannt, dass kontrollierte Experimente einen Teil der Probleme lösen können, indem sie Umgebungen vereinfachen, in denen Inventionen entstehen und die Variablen, die kreative Leistung beeinflussen entwirren. Laborexperimente scheinen ein vielversprechender Ansatz zu sein, routinemäßige sowie kreative Aufgaben zeitgleich und systematisch zu erforschen. Aktuelle Forschungsergebnisse sind angesichts des beschleunigten Wachstums im kreativen und innovativen Sektor, sowohl für Führungskräfte als auch für Mitarbeiter dieser Branchen, von hoher Bedeutung. Daher wird erwartet, dass sich diese Forschungsrichtung in den kommenden Jahren erheblich ausweiten wird. Diese Arbeit stellt einen der ersten Schritte in diese Richtung dar.

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Chapter 1

Introduction

Innovation research is well established in economic science. This is unsurprising considering the influence of innovations on economic growth and more generally, on human welfare. However, until recently economists did not pay adequate attention to routes of innovative activities and circumstances that affect inception of inventions. According to well established models of innovations, there are three major phases of innovative activities: invention, innovation and diffusion (see e.g. Hobday (2005) for review). Thus, invention is an initial phase, triggering emergence, development, and establishment of novel solutions and practices. Therefore, it is critical to study what factors facilitate the appearance of inventions. In order to achieve inventions, individuals have to come up with novel and at the same time useful ideas. In other words, creative ideas (Amabile, 1988).

Creativity has been long studied in cognitive and social psychology literature (see e.g. Mayer (1999) for review). Economists and management scientists have made relatively few contributions to this research direction. Presumably, one of the reasons that attracted authors' attention is the fast acceleration of technological advancements in the late 20th century. This led to a dramatic increase in creative jobs (Florida, 2014). To keep up with the progress, start-up firms as well as incumbents have to constantly create new knowledge, or improve already existing one. To support high demand on unorthodox solutions, company principals have to redesign working environments. An increasing number of economists and management scientists finds it scientifically appealing to analyse creative behaviour and mechanisms that may enhance or diminish creative performance. This interest is also determined by business

practitioners' desire to improve employees' creative productivity and increase the return on investment in labour force.

Tasks that are based on simple repetition of trivial, unsophisticated activities are regarded as mundane or routine. Substantially more research has been done on changing and motivating performance on routine tasks. Solutions for routine tasks are usually straightforward and most of the time, principals can incentivize agents by providing monetary rewards. The main issue in motivating routine tasks is to pay enough (Gneezy and Rustichini, 2000). While suchlike tasks are still an essential part of the work in a majority of firms, the importance and share of these tasks are decreasing. For instance, a number of technology companies is heavily investing in self-driving cars. This will cause loss of millions of (rather uncreative) driver jobs. Thus, companies require more cognitively demanding creative work, such as programming to perfect already existing programs for autonomous cars or develop new ones. This brings up few issues on employee motivation to be solved. Firstly, managers should know how routine and creative tasks differ. Secondly, and more importantly, how they should set working conditions and especially, payment schemes to increase productivity for each of these types of tasks.

One of the most important differences between these two types of tasks is that a creative task is often done for its own sake (Amabile, 1996). Individuals are intrinsically motivated[1] to build something new, whether it is for aesthetic purposes or new, improved functionality. Sometimes intrinsic motivation is crowded out by external rewards.[2] However, this is not always the case and external motivators may add to already existing willingness to exert effort for creative tasks. While creative tasks are usually found to be interesting and engaging, routine tasks are not. In other words, for routine or mundane tasks, intrinsic motivation is absent. That is why scholars usually do not discuss intrinsic motivators for such tasks. They rather concentrate on the size of monetary or other external incentives or how to provide them.

Relatively little scientific work has been done on comparing how individuals perform on these two different tasks under various payment mechanisms and contexts. As discussed above, these tasks differ on key characteristics. Therefore, it can be expected that people respond to similar incentives differently. In this thesis I study how individuals behave in different environments while

[1] See Ryan and Deci (2000) for definition of intrinsic and extrinsic motivations.

[2] Discussion of theory on motivation crowding effect can be found in work by Frey and Oberholzer-Gee (1997).

working on routine and creative tasks. The first chapter of the thesis addresses cooperation among group members after exerting efforts on these conceptually different tasks. The other chapters investigate effects of various contexts on performance. Thus, I focus on performances on routine and creative tasks as well as on the behaviour after completing the tasks.

1.1 Creativity Research in Economics and Management Sciences

Creativity has been studied from such widely different points of view that it is practically impossible to fully cover this field in few pages. Creative capacity is related to the notion of inspiration, which can be found in early Roman, Greek, Judaic, Christian, and Muslim traditions and which was based on the assumption that it gives higher power. During the Romantic era inspiration was associated to human beings and their artistic expression. During this period originality, flashes of insight, and the creative genius were praised (Ryhammar and Brolin 1999, p. 206).

From the beginning of the last century creative behaviour mainly became a research topic for psychologists. Guilford (1950) was probably the first scientist to point out that intelligence tests cannot account for certain phenomena and that other aspects of cognition, such as divergent thinking, can serve as a better explanation. Building on Guilford's work, E. Paul Torrance, "Father of Creativity", developed tests to measure creativity (Torrance, 1962). These tests are known as Torrance Tests of Creative Thinking (TTCT). They have been updated five times in 1974, 1984, 1990, 1998 and 2008 and are translated into almost 40 languages.[3] These advances in creativity research provided theories on what creativity is, why it is important, and how to measure it. The later work already addresses understanding the nature of creativity (Sternberg, 1988), how a context affects creative behaviour (Amabile, 1996), and how different variables influence creativity in organizations (Mumford, 2011).

While psychologists have been researching creativity for several decades, economists and management scientists have contributed relatively less. Arguably the main reason is that economists are interested in the final output of creative thinking, that is innovative products, services, or processes. Thus,

[3]See review in Kim (2006).

economists have focused more on innovations, devoting relatively less attention to the antecedents of inventions. Empirical studies are most frequently applied methodology to innovation research, for example, official patent statistics or micro firm-level data from surveys. However, this approach is less applicable to creativity. A more adequate method to study individual creative behaviour seem to be field and laboratory experiments.

The field experiments are complicated to administer. Few examples of such endeavour proved that it demands long term collaborations between academic institutions and commercial organizations and requires finances, which are often only in reach of leading technology companies (see e.g. Boudreau et al. 2011). Analysing pros and cons of different methodologies for innovation research, Brüggemann and Bizer (2016) suggest that field experiments are overly costly and despite the lower level of external validity, laboratory studies can be valuable substitutes for randomized field experiments. They can provide new perspective to research topics inaccessible through "traditional" empirical methods.

During the last decade a number of authors designed various experiments to model creative and innovative activities in the laboratory environment. For example, among others, addressed topics include: issues on intellectual property (Brüggemann et al., 2016, Buccafusco and Sprigman, 2011, Crosetto, 2010, Engel and Kleine, 2015), R&D competition (Aghion et al., 2014, Cantner et al., 2009) and innovation process (Asanov, 2014). Conducting controlled laboratory experiments is a prospective technique to understand how individuals perform on creative and innovative tasks under different payment schemes (Bradler et al., 2016, Charness and Grieco, 2014, Eckartz et al., 2012, Ederer and Manso, 2013, Erat and Gneezy, 2015). Experiments can also be very useful to understand how interfering in creative production affects creative output (Joyce, 2009, Sikora, 2013).

The scientific work in the last years substantially advanced economic research in this field. However, this particular direction of research, studying creative performance by using lab experiments, is relatively new. Thus, it is rather undeveloped and there are research gaps to be filled. The current dissertation addresses the topics which are not yet fully well understood and also provides new insights on issues which have not yet been analysed.

1.2 Structure of the Thesis

The purpose of this work is to contribute to the economic literature on creativity research. Other than few exceptions, the previous literature analysed creative and routine task performance separately. Such an approach is not comprehensive and lacks an important benchmark to make credible conclusions about creativity. A probable reason why scholars do not study these two tasks simultaneously is that there are very rarely routine and creative tasks that can be claimed to be sufficiently similar to make a comparison. Moreover, these tasks are usually done by different individuals. To remedy this problem, experimental methodology can be applied. Generally, laboratory economic experiments enable designing situations where everything but one aspect is changed. This eliminates uncertainties and makes it possible to relatively easily establish causal relationships.

Moreover, it can be very costly to change working environments and analyse corresponding human behaviour in organizations. Therefore, in this thesis I depend on controlled economic experiments to study: (1) How people cooperate after exerting routine and creative efforts. (2) Whether routine and creative performance can be enhanced by competitive incentives. (3) How constraints affect routine and creative performance, and (4) how individual domain/task specific skills interact with constraints and creative performance.

The second chapter studies if the *creativity effect* transfers to the social domain. More specifically, I design an economic experiment to learn if effort levels and effort types influence cooperative behaviour. In the third chapter I investigate whether different degrees of competitive incentives and provision of feedback improve routine and creative task performance. The fourth and the fifth chapters experimentally study how constraints or quality requirements affect routine and creative performance and what role creative competence plays.

Chapters 2, 3 and 4 are single-author projects. Chapter 5 is co-authored with Sanjiv Erat from the University of California, San Diego. It was presented at the London Experimental Workshop 2016. The initial idea and programming of the experiment was mainly done by Sanjiv Erat. I was primarily responsible for the literature review and for the data collection. The data analysis and the rest of the workload was shared equally by the authors.

1.2.1 Chapter 2

In the second chapter of the thesis I study if *endowment* and *creativity effects* influence cooperative behaviour. Firstly, I try to validate previously found results that higher effort causes higher valuation of endowments and makes individuals more hesitant to contribute to the common pool in a group. Secondly, I add another dimension of creative effort and check if findings on routine efforts and cooperation also hold for creative efforts.

When a group in an organization works on a creative project, members usually bring in their knowledge acquired through low or high effort. Rational economic theory suggests that behavioural *sunk costs*, i.e. effort spent on earning, should not matter while deciding what portion of endowment to contribute (Zeelenberg and van Dijk, 1997). However, recent research findings show that if someone worked harder to attain an endowment she might be more inclined to keep it private (Muehlbacher and Kirchler, 2009).

For instance, in technology companies programmers or coders often work in groups. They share their knowledge and experience to increase profitability and success of projects. Usually the group members acquire endowments through different sources and efforts. In case the previously spent effort determines willingness to contribute to the group, it becomes very important for organization leaders to manage those group members who may overvalue their endowments. However, behavioural sunk costs may actually not enter the group domain at all. In that case, company principals should use different measures to keep members committed to the group.

In this chapter I designed a laboratory experiment which models the above discussed situation. Namely, individuals earn through different sources and play a public goods game in a small group.[4] According to the results of the experiment, neither effort level nor effort type have effects on cooperation. When it comes to social behaviour, individuals usually base their decisions on their previous experience with other groups, their social value orientation, and personality traits. Thus, if there is a lack of cooperation in a group, it should be ascribed to individual characteristics, rather than to efforts that group members have exerted to acquire their endowments.

[4]Cabrera and Cabrera (2002) argue that often knowledge sharing in an organization corresponds to a cooperation dilemma, similar to the public goods dilemma.

1.2.2 Chapter 3

In the third chapter I report on an economic experiment which investigates whether competitive incentives can affect routine and creative performance. Previous research findings suggest that a routine performance can be enhanced by putting individuals in a competition environment. However, results are not unequivocal for creative tasks. Rationally speaking, individuals should respond to competition by increasing their effort to beat the competitors and receive a reward. In fact, some scientists demonstrate that competition "chokes" creativity (Erat and Gneezy, 2015), others did not observe any effect of competitive incentives for creativity (Eckartz et al., 2012) and some even found positive effect of tournament incentives (Bradler et al., 2016). Thus, more research has to be done in this direction.

Usually, organizations have a fixed budget to spend for reimbursing employees. The dilemma that organizational leaders face is to determine how to allocate these funds so that the highest productivity is reached. One way is to pay everyone equally, regardless of their performance. The other options could be to pay depending on performance (piece-rate) or inflict competition. While there could be many different variations of competitive or tournament incentives, one way is to award a prize to the best performers and pay a minimum wage to the rest. Studying such payment schemes, behavioural scholars usually studied only one level of competition. However, the effect of competitive incentives may depend on the intensity of competition (i.e. the number of competitors and the size of reward). For example, on the one hand, low competition can be more likely to encourage routine or creative workers and increase performance. On the other hand high competition inheres substantially lower probability of winning, therefore, it is more expected to cause choking under competitive pressure. This usually increases the number of quitters and in the end, decreases average performance.

The results of the experiment suggest that indeed, low competition with low prize increases routine, but not creative performance. High competition has no effect in comparison to flat rate payment for both types of tasks. High competition with provision of feedback during the competition, decreased performance. Thus, in this project I integrated two conceptually different tasks in a single experiment and find evidence that low competition is supportive for routine tasks, but not for creative tasks and that high competition and moreover, high competition with feedback is least optimal for improving creative performance.

To summarize, this chapter expands the existing literature in three ways: Firstly, it investigates effects of competitive incentives for two different types of tasks. Secondly, it analysis effects for two levels of competition (low and high). Lastly, it studies effects of feedback in a high competition condition before the task is completed. The experimental evidence suggests that competitive incentives have different effects depending on the intensity of the competition, type of task and whether the performance feedback is provided or not.

1.2.3 Chapter 4

In the fourth chapter I study effects of constraints for routine and creative tasks. Early work on this topic has shown that if creators are restricted in thinking freely on a given task, their performance decreases (e.g. Amabile 1978, 1996, Amabile and Gitomer 1984). The main reason is that creators like to explore and invent without being framed. Once they are externally limited, they cannot be as productive. Some of the recent research findings suggest that moderate constraints may have positive effects on outcomes by challenging creative workers or guiding them to superior creative solutions (Joyce, 2009, Moreau and Dahl, 2005).

Usually firms want to have high levels of creative output. To ensure this, they try to facilitate production of novel ideas which are supposed to transform into new products or services. Ultimately firm leaders want to have a high number of qualitatively advanced creative solutions which will fulfil or exceed the company demands. To achieve this, one can impose constraints or requirements for creative tasks. If the below certain threshold quality is not rewarded, employees are forced to give more effort and generate highly creative solutions. In this way creative workers may find the task even more interesting and engaging.

To test whether constraints can positively impact average creativity, I designed a laboratory experiment and tested how low and high levels of constraints influence average creativity. Creativity was measured considering both, quantity and quality of creative solutions. I manipulated constraints by setting low and high quality thresholds for creative solutions. In the constraint treatments, if the solutions generated by the participants were below these thresholds, the participants were not rewarded.

According to the results both, low and high constraints are detrimental for

routine and creative performance. Further analysis shows that it takes some time to adapt to constraints. After learning the constraints, the participants performed as well as unconstrained ones. However, this learning over time was observed only for low constraints. Regardless of effort type, high constraints were always detrimental for performance.

There was one interesting and at the same time unexpected aspect of decreased performance in low constraints condition. Namely, participants who completed the unconstrained condition were building substantially more high quality creative solutions than the participants in constraint treatment. Even though constrained subjects were directly required to come up with only highly creative solutions, participants were less productive compared to unconstrained ones. This might suggest that individuals were building up on initial creations. That is, it could be a case that a small reward for short solutions allowed development of more qualitatively complex solutions. In order to explore this phenomenon I designed a follow-up experiment to investigate the causes and implications of this result and also, explore the role of domain-specific skill for a creative performance.

1.2.4 Chapter 5

In the fifth chapter we[5] study how domain-specific or task-relevant skills interact with constraints. Generally, it is well known that if an individual has special knowledge related to a given creative task, she will handle it easily.[6] However, until now (to the best of our knowledge) no research has investigated the interaction of skills with constraints. In this paper we argue that depending on the skill level, constraints may have a positive or negative effect on creative performance. On the one hand constraints may have a negative effect, preventing gradual development of creative ideas, on the other hand constraints may enable the focus on high quality solutions and with this enhance creative performance.

Production of novel ideas which do not meet certain quality standards (i.e. "worthless" ideas) can be regarded as failure. Traditionally, managers asserted

[5]The chapter is co-authored with Sanjiv Erat, from the Rady School of Management, University of California, San Diego.

[6]See componential model of creativity by Amabile (2012, 1983).

that in successful companies "failure is not an option".[7] However, attitudes towards failure in innovative firms have changed recently. Failure in producing novel ideas may be an important phase towards success (Ederer and Manso, 2013, Manso, 2011). It could serve as an instrument to facilitate build-up of novel ideas and be a roadmap to breakthrough innovations.

In order to study these two different effects of constraints on creative performance, we design an economic laboratory experiment. We externally manipulate incentives and constraints and use a survey to elicit subjects' task-specific skill level. In line with previous findings on incentivizing creativity, we find that the piece rate payment has no effect on performance. However more interestingly, in piece rate payment conditions, a domain-specific skill level determines whether the constraints have a positive or a negative effect on creative performance. Highly competent creative workers are able to respond to constraints by concentrating on highly valuable solutions and increase overall performance. Whereas less competent workers suffer from imposed constraints. Furthermore, in support of our hypotheses, we find evidence of creative build-up among low skilled participants. In the unconstrained condition, they were more frequently extending less creative solutions into more creative ones and presumably, that was the main reason why constraints appear to be detrimental for these individuals.

The findings of this research are highly relevant for decision makers in innovative firms. While managers often try to provide maximum freedom for creative workers, our results point toward the value of more explicit and proactive intervention, such as setting constraints for creative tasks, especially when the creators are highly-skilled. More broadly, employees' skill (or task related knowledge) level must be a key consideration when designing the appropriate payment mechanisms for creative workers.

[7]The phrase is attributed to Gene Kranz, flight director of Gemini, Apollo and Space Shuttle missions.

Chapter 2

Effects of Creative and Routine Efforts on Cooperation

2.1 Introduction

Cooperation is fundamental for human interaction. From early years of human development, cooperation was essential for survival, whether it was about joining efforts to hunt or fighting enemy. Cooperation enabled sharing and expansion of knowledge, resulting in improved living standards. Many authors argue that cooperation is the key feature of human behaviour which empowered the extraordinary progress of the mankind (see an overview of the evolutionary study of cooperation in West et al. 2011). Therefore, it is not surprising that scholars have devoted huge amount of scientific effort to learning this phenomenon.

Researchers from different fields have explored cooperation in various settings. One of the most frequently used method in economics and psychology is experimentation. Probably the most widespread experiment is Public Goods Game (see review e.g. in Kagel et al. 1995). In this game it is optimal if everyone contributes to common pool, however, it is individually rational to free ride. Thus, the game creates a dilemma, a situation when on the one hand if no one contributes, public good will not be provided and everyone will miss an opportunity to increase their welfare. On the other hand if one contributes without others reciprocating then her wealth will drop below the original level. This, often leads to tragedy of commons, when single individuals are exploiting

the public good without contributing to it (Hardin, 2009).

Scientists have conducted hundreds of public goods experiments by granting endowments to participants and manipulating various conditions. However, less attention has been devoted to studying how people behave when they earn their endowments, that they later use. At a starting point it is scientifically justified to simplify economic laboratory experiments, it facilitates to effectively study complexities (Smith, 1994). From this perspective, granting participants their endowments was a right choice and eased experimental work. However, after several decades of research, it is important to relax the assumption that individuals receive their endowments as "heavenly manna". To fill the gap some researchers (e.g. Cherry et al. 2002) designed experiments where the participants had to earn their endowments. While the research findings are mixed, the majority of authors argue that earning endowments makes people endowed to their earnings. As a results they are more likely to overvalue their possessions and avoid sharing it with others.

Although, in general, the levels of effort exerted for earning endowments should not matter for making a decision on how to spend it, the research suggests that people change their behaviour when the behavioural *sunk costs* (i.e. efforts) are present (Zeelenberg and van Dijk, 1997).

The principle that people value more what they already possess, is well documented in behavioural economics. This bias is named *endowment effect* (Kahneman et al., 1990, Loewenstein and Issacharoff, 1994). Moreover, some authors (e.g. Franke and Schreier 2010, Norton et al. 2012) argue that exerting effort makes individuals overvalue result of their work. Along these lines, it is credible to assume that if effort affects decision making, then exerting higher effort should also be differed from exerting low effort (Franco-Watkins and Acuff, 2013).

In addition to that, it has been demonstrated that creative effort amplifies endowment effect, causing even higher over-valuation of created artefacts. This bias is referred as a *creativity effect* (Buccafusco and Sprigman, 2010, 2011). Although the effects of real efforts as well as size of efforts on cooperation has been researched (Muehlbacher and Kirchler, 2009, Spraggon and Oxoby, 2009), to the best of my knowledge there is no research done on creative efforts and cooperative behaviour. Considering the fact that number of creative jobs and innovator groups is dramatically increasing (Florida, 2014), it is important to study whether creative effort affects cooperation in small groups.

In order to better understand if behavioural biases caused by exerting effort shape cooperation, in the current paper I investigate how effort size (low vs high) and effort type (routine vs creative) affect contribution decisions in Public Goods setting. More precisely, I designed an economic laboratory experiment with four treatments. In the first two treatments, participants had to earn their endowments through routine or creative effort and then contribute to public goods, in the other two treatments, individuals earned in the same way but had to exert substantially more effort to acquire the same endowments and also decide on contributing to the public goods.

The results show that effort size and effort type do not change cooperation levels. Instead, participants of the experiment depend on their social value orientation and personality traits while deciding what portion of their endowments to contribute to the common pool. Thus, the current project provides further evidence for the viewpoint that efforts do not usually shape social behaviour, such as cooperation in small groups (Cherry et al., 2005).

The paper is organized as follows: First, I overview the related literature. Second, I set the research questions and hypotheses. As a next step I provide a detailed explanation of the experimental design. Finally, I present the results, discussion of the findings and suggestions for future research.

2.2 Literature Review

2.2.1 Origin of Endowments and Cooperation

From the rationality perspective the source of money should not matter while making a decision on how to spend it. Each unit of money has the same value whether it was earned through hard work or found in a street. In fact Zeelenberg and van Dijk (1997) showed that this is not the case and individuals act depending on how high their behavioural sunk costs are. Scholars from areas of social psychology and behavioural economics have observed changing behaviour depending on whether participants of a laboratory experiment earned their resources or not (e.g. Cherry et al. 2002, Franco-Watkins and Acuff 2013). The findings are mixed: some authors found that subjects are not giving up their wealth easily when they have not been granted it and are rather hesitant to invest or put their earnings under risk after working for it. Conversely, some results show that subjects are more generous and eager to

give up their earnings easily when they have exerted a certain amount of effort for it (Spraggon and Oxoby, 2009). While there is a sufficiently large body of research in this direction, in what follows I overview some of the most relevant and interesting findings.

Cherry et al. (2002) designed a dictator game, which controls self-interested strategic behaviour by giving a person complete control over the distribution of wealth. Compared to the previous dictator games (e.g. Hoffman et al. 1996) the participants of the experiment played with earned wealth rather than unearned wealth granted by the experimenter. The main argument for this is that the earnings have to be legitimate to produce a rational behaviour. The key discovery was that the other-regarding behaviour is greatly diminished when the bargaining involves earned wealth, and this behaviour is nearly eliminated when the earned stakes are combined with anonymity. In other words, earning an endowment led decision makers to dramatically reduce a game theoretic off-equilibrium behaviour (i.e. giving away positive amount of money). As a result, the authors conclude that the high cooperation levels and the lack of free riding could also be caused by the windfall endowments of the players.

Despite this conjecture, Cherry et al. (2005) could not find supporting evidence that the origin of endowments affects group members' contributions to the public good. They designed a classical linear public goods game, with two stages: first earning and then contributions to the public good. In the earning treatment (T1) participants had to solve a Graduate Management Admission Test (GMAT)[1] to earn endowments. In the second treatment (T2) the endowments were windfall. The game was played only once to avoid a reciprocal behaviour by the group members in future periods, triggered by generosity or defection in the first periods. The generated data indicates that there is no significant difference for subjects who earned their endowment relative to those with windfall endowments. Thus, although the experiment protocol of earning endowments was similar to that by Cherry et al. (2002), the results differ, which as the authors themselves presume could be because of the difference between contexts. That is, the public goods game represents a more complex task, demanding greater cognitive effort and involving simultaneous decisions by the other contributors.

Surprisingly, Spraggon and Oxoby (2009) found the opposite effect of earning money. In their two person public good game some participants earned their endowments through the GMAT questions, while the others were granted.

[1]For more information on the GMAT test see www.mba.com.

They observed that those who earned their endowments contribute more and those who were given their endowments contribute less. As a possible explanation they suggest that such behaviour is due to the "anticipatory reciprocity" (also discussed by Cherry et al. 2005, Kroll et al. 2007). That means that earners expect that non-earners will cooperate and therefore they contribute significantly more expecting this reciprocal behaviour.

Earlier experiment by Loewenstein and Issacharoff (1994) showed that students, after performing a task, exhibited a stronger endowment effect towards a mug which they received as a compensation, compared to those who simply received the same mug as a gift. To test whether the level of effort really impacts contribution in a public good setting Muehlbacher and Kirchler (2009) designed an experiment where participants had to earn their endowments though an easy or an effortful task. They hypothesize that those who exerted more effort to earn money should value their endowments more and contribute less. An important novelty in their design is that subjects within groups were not informed that their group members performed different effort tasks. Therefore, they claim to measure "pure impact of effort on cooperation". Their experiment was implemented as follows: In a low-effort condition participants had to watch a TV cartoon series and were questioned about the episode synchronically. In a high-effort condition the same episode was shown but they had to listen to a soundtrack from a different episode. The results of debriefing the subjects proved that this manipulation was successful and the participants contributed significantly less when they were assigned to the high-effort treatment. The approach is somewhat questionable. Participants could suffer from irritation or distraction if they had to listen to sounds which are not in unison with what they saw. Hence, less contributions could have resulted not necessarily from the higher effort, rather from other unobserved factors, such as changes in mood. Moreover, in their experiment incentives were very low: participants earned 50 ECU, while the exchange rate was 42 ECU = 1 EUR. Therefore, to validate the results of the study further replication and modification of the design are needed.

The notion of "House money effects" was proposed by Thaler and Johnson (1990) and it describes increased risk seeking propensity under certain conditions. They discovered that individuals choose a risky option more frequently in a two stage game, which allowed certain gains in the first stage and a risky option in the second stage. While the distribution of gains in two lottery options was the same, players were more risk seeking in a situation when they had some earning guaranteed in the first stage. Clark (2002) in-

vestigated "house money effects" in the public goods game. He assumed that the decisions about contributions involve a risky behaviour as the other group members can always free ride and enjoy benefits at the other's expense. In other words, he expected decreased cooperation in the public goods game, in a situation when participants brought their own money in order to take part in the experiment. Thus, the experiment did not involve earning resources through real effort task. The author could not find significant difference between the average contribution levels in the own money and the house money (here it means windfall) treatments.

Harrison (2007) reconsidered the evidence from Clark (2002)'s experiment. After using appropriate statistical methods for the data analysis he found that the "house money" does have an effect in the standard public goods game. It is estimated to reduce the probability of providing something by 8.2 percent points and this effect is statistically different from zero ($p - value < 0.01$). Despite the final confirmation of the house money effect in the public goods setting the method of asking participants to bring their money to a laboratory is unusual and somewhat problematic. An experimenter cannot control how much effort participants gave to get the money. Therefore, although the authors are often referred to in the literature explaining cooperation in the PGGs, no implications can be made about the effort size and the cooperation levels.

Marginally relevant to the topic, since the authors take a look at bargaining rather than cooperation, is a paper by Franco-Watkins and Acuff (2013). They examined how effort affects perceptions of fairness and allocation of resources during bargaining situations. In previous literature scientists relied on one shot bargaining, or the ultimatum game (e.g. Güth et al. 1982) with windfall money, as a source of bargaining resource. The proposers usually found an equal split the fairest. To test how real effort influences valuation and bargaining, Franco-Watkins and Acuff (2013) demanded that experimental subjects perform a self-arbitrary task, requiring to click a computer mouse for 100 times and self-performance task – answering at least 70% of 20 trivia questions. The results indicated that those who completed the performance task demanded significantly more money when the other party did not have to endure the same task. That means, that the willingness to accept more money increased when others performed no task and at the same time the willingness to pay was decreased when others performed no task. Thus, even if the effort was not directly linked to the second phase, it had a small but significant effect on bargaining.

To summarize, the results are mixed: some authors found no impact of earning endowments on cooperative decisions in the public goods games, while others did observe an influence of effort level on cooperation. In some cases, the higher the stated efforts for earning was, the less cooperative subjects became. However, even if it seems to be quite intuitive that individuals get more attached to something they worked for, there are some exceptions when no such effect or even the opposite effects were found. The rational argumentation also suggests that efforts should not matter at all. Thus, the topic can still be explored further to set clear links between origins of wealth and the decision making on cooperation in a public goods setting.

2.2.2 Creativity and Endowment Valuation

All progress and innovation depends on ability to change existing thinking patterns, break with the present and build something new. Therefore, creative thinking is an extraordinary capacity of a human mind and has recently become matter of central importance for interdisciplinary research (Dietrich and Kanso, 2010). Much attention has been paid to the organizational and managerial issues pertaining creativity, as it represents a basic and critical element for innovation process (Udwadia, 1990). Since groups are often built of creator individuals, it is important to know how creative efforts impacts individual social behaviour in a group context. This may help to analyse group members' decision making and overall group performance. Thus, to link cooperation and creativity, in this section I overview some scientific papers on creativity in experiments which are most relevant.

To understand how creativity affects decision making Buccafusco and Sprigman (2010, 2011) conducted two experiments. In the first one, some of the participants wrote three-line poems, some were told that they owned the poems and the others were potential buyers. One of ten such poems had a chance to win a prize. Then the creators and owners were asked to name the price for what they were willing to sell their poem. The values of their poems should theoretically be the value of prize divided by ten. However, subjects demanded significantly more than expected. More specifically, the money that the authors were willing to accept was more than four times higher to what rational choice theory would predict (i.e. probability of winning multiplied by the value of the prize). The willing to accept by creators was two times of what bidders were willing to pay. Thus, the owners felt more attached towards

the poems that they possessed and for the authors of the poems, endowment effect was even greater. This amplified endowment effect caused by being an author oneself is what Buccafusco and Sprigman name *creativity effect*.

The endowment effect describes situations when the owners' willingness to accept the minimum price for their possession is greater than what potential purchasers are willing to pay. This phenomenon can be a source of substantial inefficiencies on markets. Thus, to examine a strengthened endowment effect, Buccafusco and Sprigman (2011), in their follow up paper, exclusively focused on valuation anomaly that is related to creation of new works. What they define as creativity effect may be not less important and significant than endowment effect. It could be a reason for inefficient allocation of property rights or the lack of cooperation between creator groups. The second experiment was similar to the first. The authors asked painter students from the School of the Art Institute of Chicago to paint paintings and play the game identical to the previous one. The new data showed that the valuation gap between the creators (of paintings) and potential buyers was 4-to-1. This suggests that higher efforts incorporated into creation leads to further divergence in valuations.

Attraction and over valuation of self-constructed products have been observed by other authors as well. This phenomenon is called as the "IKEA effect". Norton et al. (2012) have conducted a simple experiment and showed that the participants of the experiment valued origami paper cranes significantly more when they built them themselves. The same pattern was found by Franke and Schreier (2010). In their experiment participants who designed scarves valued it more than the same type of scarves designed by others. Finally, Dohle et al. (2014) found what they call "I cooked it myself" - effect. In this experiment participants liked and consumed significantly more self-prepared drinks than the same drinks prepared with exactly the same ingredients and receipt by others.

In what follows, I set research questions and hypotheses based on the provided theoretical discussion.

2.3 Research Questions and Hypotheses

The experimental literature, discussed above, demonstrated that exertion of effort to acquire endowments ends up in different behaviours by subjects. In

most of the cases hard work causes higher endowment effect towards earnings. That means participants value their resources, earned through hard work more and become more hesitant to give them up. Therefore, the first research question is:

1) How do earning endowments through different real effort tasks with different levels of effort affect cooperation in PGG?

Since contribution to public good contains some risks, higher valuation of endowments could cause less contributions by group members. In other words, they face uncertainty about others' decisions and show more risk-averse behaviour when they have earned their endowments through a real effort task. Working causes higher valuation of endowments and therefore subjects might cooperate less when they have earned their resources through difficult (high effort) tasks. Thus, in line with Muehlbacher and Kirchler (2009), **hypothesis I** can be formulated as follows:

- *Contributions to the public good after earning through high effort task will be lower than the contributions after earning through low effort task.*

In addition, creation can lead to amplification of the endowment effect (so called creativity effect) and emergence of the valuation gap (Buccafusco and Sprigman, 2010, 2011). Creators get attached to their creation and overestimate its importance. Therefore, it can be presumed that the creativity effect may influence individuals' behaviour, when they have to contribute to public good earnings from their creative endeavour. Thus the second research question is:

2) Do subjects change their cooperation behaviour if they have exerted creative effort?

Although creators are often too attached to their earnings, sometimes creators are eager to share their creation with others as well. For example as it is in the case of Free/Open Source Software (FOSS) (Crosetto, 2010). Such attitude may even have counter effect on contributions and actually increase them. However, this case seems to be more of an exception than a common pattern. Generally, when there is no standard of common sharing, inventions are assessed by creators themselves and moreover, often overvalued. Therefore, under such circumstances free riding incentives will be higher and cooperation level is more likely to be lessened. Thus, **hypothesis II** can be formulated as follows:

- *Contributions to the public good after earning through creative effort task will be lower than contributions after earning through routine effort task.*

In most social dilemma situations, people cannot communicate with one another and therefore they are uncertain about the decisions of their fellow group members. To deal with this kind of environmental uncertainty, participants use their own social value orientations and personality traits as a guideline for choice behaviour (de Kwaadsteniet et al., 2006). Thus, the third research question is:

3) How do individual personality traits and Social Value Orientation affect cooperation?

Social value orientation (SVO) is defined as a personality variable that indicates how people evaluate outcomes for themselves and others (de Kwaadsteniet et al., 2006, Messick and McClintock, 1968, Van Lange and Liebrand, 1991). For example, Van Lange (1999) categorized SVO as (a) cooperation, i.e., the preference to maximize joint outcomes and establish an equal distribution, (b) individualism, i.e., the preference to maximize own outcomes, and (c) competition, i.e., the preference to maximize relative advantage. Cooperators are usually considered as prosocials, individualists and competitors – proselfs. Depending on this definition and findings by Murphy et al. (2011), **hypothesis III (a)**, can be formulated as follows:

- *a) SVO will be predictive for cooperation levels: Prosocials will contribute more to the public good than proselfs.*

The research on personality from the last few decades, has proven that the personality measures may explain human behaviour in different dimensions, such as cooperation within groups (e.g. Volk et al. 2011). Researchers investigating the relationship between the Big Five personality traits and social behaviour (e.g. Volk et al. 2011) found that in PGG setting agreeableness and prosocial values were indicative of individual preferences for cooperation. In addition, a laboratory study by LePine and Van Dyne (2001) observed a positive relation between cooperation and personality traits: agreeableness, emotional stability and extraversion. Thus, **hypothesis III (b)** can be formulated as follows:

- *b) The Big Five dimensions of agreeableness, emotional stability and extraversion will be positively related to cooperation.*

2.4 Experimental Design

Procedure and design. The experiment had two, high and low effort treatments, with two types of tasks, routine and creative. Hence, there were four conditions (see Table 2.2). The experiment was conducted in two phases. That is, for example, in the low effort treatment participants earned their endowments through a routing task, made their contributions in a standard PGG, then they earned through a creative effort task and again made their contributions to the standard PGG without getting feedback in between. To eliminate order effects the sequence of the tasks were switched in different sessions. Similar design was applied in the high effort treatments. The only difference was the amount of effort needed to solve the tasks. The number of observations in different treatments and different sequences of the tasks were balanced. LTR1 and HTR1 means low and high effort treatments with the task sequence: routine task - creative task. LTR2 and HTR2 denote the opposite sequence: creative task - routine task (see Table 2.1).

	LTR1	**HTR1**	**LTR2**	**HTR2**
N of obs.	27	36	27	33

Table 2.1: Number of observations in different sessions with varied sequence of tasks

After reading the instructions on how the experiment is organized and how they are supposed to play the game, the subjects had the opportunity to observe how hypothetical contributions can be redistributed using PGG calculator (see instructions in Appendix 2.8.1). There were three person groups. The participants were informed that they would earn twice and contribute to PGG twice, however only one of their decisions would be pay-off relevant. Any positive contribution was doubled and redistributed among the three group members.

$\pi_i = p_i + 1/2 \sum_{i=1}^{N}(j_i)$

Where,

- π_i - Earnings of i
- p_i - allocation to personal account

- j_i - allocation to joint account
- N - number of group members

In this PG experiment marginal per capital return (MPCR) was 0.66. This is higher than usually used range between 0.4 - 0.5. The reason to opt for somewhat higher MPCR is that the research goal of the current project was to observe probable decline in contributions across different treatments. The higher MPCR makes it more likely to detect treatment effects if there are any. As in most PG experiments, here it is socially optimal if everyone contributes everything. However, for individuals the dominant strategy is to contribute zero in all of the treatments (Thaler and Johnson, 1990). After getting to know how the PGG works, the subjects answered control questions. The subjects earned 50 ECU in all treatments, i.e. there was no inequality between group members and across groups. After the control questions they solved real effort tasks.

	Real-effort task	**N of obs.**
Treatment "R.L.eff"	Counting a letter	54
Treatment "R.H.eff"	Counting two letters	69
Treatment "C.L.eff"	Creating words	54
Treatment "C.H.eff"	Creating more words	69

Table 2.2: Experimental conditions

Real effort tasks. Examples from the previous literature comparing behaviour in PGG after effort exertion include: Graduate Management Admission Tests (GMAT) (Cherry et al., 2005, Spraggon and Oxoby, 2009); and answering questions about plot and visual images from a 6 minute episode of TV cartoon (Muehlbacher and Kirchler, 2009).

In this experiment, in the routine effort treatments, the participants had to count one or two letters within given strings of letters.[2] For example, count how many times a letter "a" appears in characters strings with different lengths, the longer the letter strings were, the more points subjects received. After surpassing a certain threshold of points participants would earn 50 ECUs and automatically proceed to the next stage (see Figure in Appendix 2.8.2).

[2]The task was inspired by the real effort task designed by Rey-Biel et al. (2011).

In the psychological creativity research literature, authors often ask subjects to think of creative stories or creative solutions to open questions, which are modifications of the Torrence Test (Torrance, 1968). Other examples of creative or innovative tasks include: Writing three line poems; Paint paintings (Amabile, 1979, 1985, Buccafusco and Sprigman, 2010); Designing an Automobile (Cantner et al., 2009); Word creation task (Eckartz et al., 2012) and word extension (modified scrabble) tasks (Crosetto, 2010).

In this experiment I applied a word creation task[3] similar to the task, used by Eckartz et al. (2012). The main reasons behind are that it has many aspects of a creative task and it mimics quite well a creative innovation. Moreover, it is one way to avoid using the most widely applied consensual assessment technique (CAT) (Amabile, 1979). The CAT method, which requires selection of judges for assessment of creative outputs is time consuming and impractical (Amabile, 1996). In addition to the fact that the task, that I use, takes less time than other options, it is easy to program, objectively assesses creativity and makes it possible to count efforts exerted by players (see Figure in Appendix 2.8.2).

The longer words the participants built, the more points were granted (see Table 2.3). After getting more than a threshold level[4] students earned 50 ECUs and proceeded to the next stage. The difference between low and high effort routine tasks was that in the high effort treatment subjects had to count two letters in the same letter strings and collect twice more points. In the high effort creative task subjects had to create words from the same letter string, however they had to collect one and half times more points than in the low effort creative task. It has to be emphasized that effortfulness of routine and creative tasks were maximally approximated: In the low effort routine task solving the longest letter string would suffice to proceed. Likewise, creating the longest words (which students could usually come up with) was enough to collect the necessary points. While doing the high effort treatment students had to solve minimum of three letter strings and find about three words to proceed.

Finally, after making the second contribution decision, the subjects were

[3]I am thankful to Diego d'Andria and Igor Asanov for providing a code, implemented in the programming languages Ruby and R, to generate the letter string and the list of possible words for the creative effort task.

[4]Students could collect up to 600 points with the given letter string. However, thresholds were 18 points in low effort treatment and 27 points in high effort treatment to keep the task sufficiently effortful, but not too difficult.

	Words from the letter set " a c c d e e e g i n s t "
ad	1 + 2 = 3 points
and	1 + 2 + 3 = 6 points
cats	1 + 2 + 3 + 4 = 10 points
...	...
teasing	1 + 2 + 3 + 4 + 5 + 6 + 7 = 28 points

Table 2.3: Measuring creativity: Longer words generate more points (Eckartz et al., 2012)

asked manipulation-check questions. Then, they were informed which of their contribution decisions was pay-off relevant, about the amounts of the contributions by their group members and their total profit. As a last step, they answered SVO (Murphy et al., 2011) and personality (Gosling et al., 2003) questionnaires. They were remunerated and released.

The experiment was conducted in Z-tree (Fischbacher, 2007). The participants were recruited by Online Recruitment System for Economic Experiments (ORSEE) (Greiner, 2015).

2.5 Results

For the statistical analysis and graphs I used R software (R Core Team, 2013).

The experiment was conducted at the Friedrich Schiller University Jena, during November 2015.[5] In total 123 subjects have participated in the experiment, majority of them were students at the university. The average earning was 8 euros (with a range from 3.8 to 11.2 euros), for a 45 minute experimental session, which is 25 % higher than minimum student assistant salary.

Manipulation check. To enable comparison of the effort levels exerted, perceived difficulty of the tasks and exerted creative effort, the following manipulation questions where asked to the subjects: 1. In comparison to the first

[5]The experiment was conducted in German language. In order to make sure that the participants were fluent in German, they took a short language test (developed by Kirchkamp and Reiß 2011). Two of the participants failed the test and therefore were disqualified from the experiment.

task did you feel that the second task required higher degree of effort? (1= same degree of effort; 8= too high effort) 2. In comparison to the first task, did you feel that the second task was as easy as the first task ? (1= as easy as the first task; 8= too difficult) 3. In comparison to the first task, did you have feeling that the second task required creative effort? (1= same degree of creative effort; 8= too high creative effort)[6] Results of manipulation check questions showed that the participants considered creative task to require a high level of creative effort ($p < 0.05$). The effort level as well as the perceived difficulty was not significantly different for creative and routine tasks in the same effort level treatments. The difference between the perceived effort levels needed to perform on tasks in low and high effort treatments was significant at $p < 0.01$ level.

In Figure 2.1 contribution frequencies are presented across different treatments. Unlike previous research by Muehlbacher and Kirchler (2009) (where there was only one free rider among all the participants) in this experiment, the portion of the absolute free riders, those who contributed zero is substantial. The reason behind is the adequate incentivization, which heightens internal validity of the experiment.

In Figure 2.2 mean contributions across treatments are displayed. As it can be seen, there are no significant differences across treatments, which means that the type of task and the effort levels are not indicative for the chosen level of cooperation (See Boxplot and the plot for Anova for the contributions across treatments in Appendix 2.4).

Table 2.4 provides the results from the paired t-tests for the same levels of efforts and the results from the Welch two sample t-tests for different levels of effort. The examination of the means confirms that there is no significant statistical difference between the means.

To identify the effect of effort type on contribution size, I first pooled all contributions and regressed[7] them on effort type (see Table 2.5). Performing low effort routine task leads to slightly higher cooperation in comparison to low effort task, however the difference is not significant ($p - value > 0.1$). Hence, hypotheses I and II are not supported.

Doing Tobit regressions (see Table 2.6) with dummy variables for the task

[6]In different sequences of the tasks, manipulation-check questions were reformulated so that subjects always compared the creative task to the routine one.

[7]For the regression tables I used Stargazer package for R program (Hlavac, 2014).

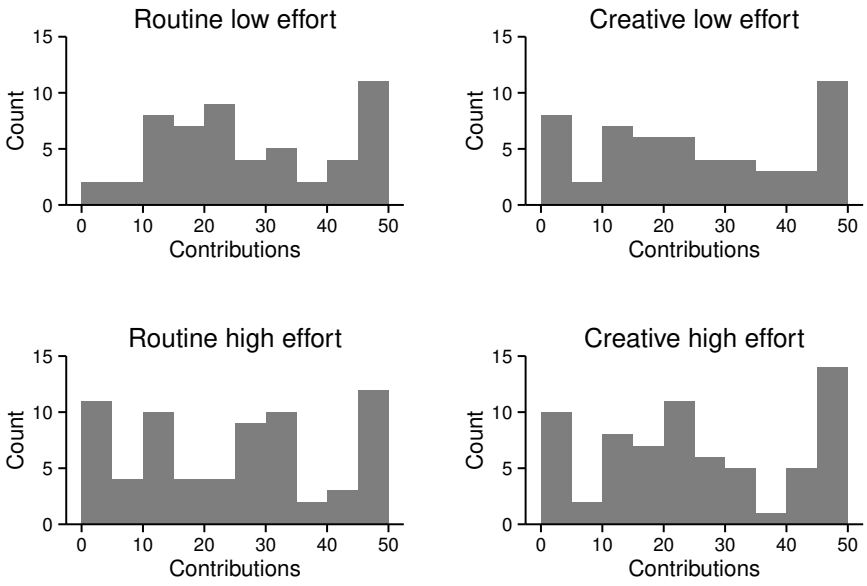


Figure 2.1: Frequency of contributions across treatments

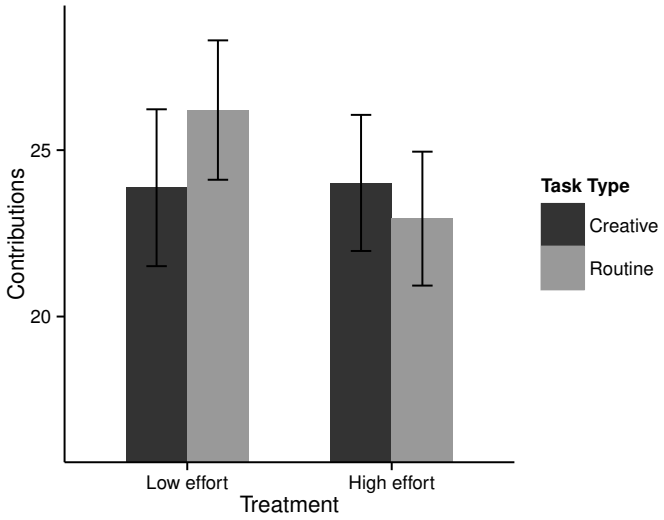


Figure 2.2: Mean contributions across treatments

	R.Low.eff - C.Low.eff	Results
1	Paired t-test:	t(53) = 1.29, p = .201, d = 0.25
	R.High.eff - C.High.eff	Results
2	Paired t-test:	t(68) = -1.29, p = .200, d = -0.22
	R.Low.eff - R.High.eff	Results
3	Welch Two Sample t-test:	t(117.78) = 1.12, p = .264, d = NA
	C.Low.eff - C.High.eff	Results
4	Welch Two Sample t-test:	t(112.95) = -0.05, p = .963, d = NA

Table 2.4: T-tests

	Dependent variable:		
	Contributions		Contributions
	OLS/Censored OLS		*Tobit*
	(1)	(2)	(3)
R.L.eff	2.189	0.736	3.261
	(3.024)	(2.215)	(4.256)
R.H.eff	-0.144	0.753	-0.542
	(3.024)	(2.314)	(4.278)
C.L.eff	-1.072	1.159	-2.025
	(2.834)	(2.127)	(4.000)
Constant	24.014***	20.362***	25.019***
	(2.004)	(1.512)	(2.831)
Observations	246	171	246
R^2	0.005	0.002	
Adjusted R^2	-0.007	-0.016	
Log Likelihood			-860.309
Residual Std. Error	16.646 (df = 242)	10.365 (df = 167)	
F Statistic	0.402 (df = 3; 242)	0.102 (df = 3; 167)	
Wald Test			1.591 (df = 3)
Note:			*p<0.1; **p<0.05; ***p<0.01

Table 2.5: Cooperation and types of efforts

type and effort level provides positive coefficient for low effort routine task. However, it is not significant ($p - values > 0.1$). Therefore, the influence of task type and effort level are not proved.

In Appendix 2.8.5 I dichotomized the dependent variable, distinguishing between zero and positive contributions.[8] For the routine effort task, the effort level dummy is marginally significant for model (3), indicating that higher

[8]It has to be mentioned that some authors argue that dichotomization of quantitative variables is rarely defensible and often will yield misleading results (MacCallum et al., 2002).

	Dependent variable:		
	All Contributions	Contribution R. task	Contribution C. task
	(1)	(2)	(3)
Effort type dummy	0.548		
	(3.001)		
Effort level dummy		-5.109	0.581
		(3.981)	(4.577)
Constant	24.785***	28.093***	24.542***
	(2.130)	(2.980)	(3.434)
Observations	246	123	123
Log Likelihood	-861.089	-436.946	-422.745
Wald Test (df = 1)	0.033	1.647	0.016
Note:			*p<0.1; **p<0.05; ***p<0.01

Table 2.6: Dummies for task type and effort level

effort would cause less positive contributions.

Interestingly, the number of zero contributions to the public good after the creative effort task was 33% higher than the number of zero contributions after the routine task. Despite finding no difference in mean contributions across treatments, this finding relates to hypothesis II, which predicted that creative effort should lessen cooperation.

In order to analyse the effects of Social Value Orientation, I applied the methodology developed by Murphy et al. (2011). The personality traits of the participants were measured by the Ten-Item Personality Inventory (TIPI) by Gosling et al. (2003). Correlation among the Big Five measures and SVO is provided in Appendix 2.8.4. According to the results, SVO is positively related to contributions ($p - value < 0.05$), extraversion is also positively related to cooperation, however only after performing routine effort task ($p - value < 0.05$), for the creative effort task significance was marginal ($p - value < 0.1$). Surprisingly, agreeableness is negatively linked to the contributions ($p - value < 0.05$) (All regression results are reported in the appendix 2.8.5[9]).

[9] *Note:* In all regressions second model includes reversed measures for the big five personality traits.

2.6 Discussion

In the current paper possible effects of earning endowments on the cooperation decisions have been investigated. The previous research has identified that behavioural sunk costs, i.e. exerting effort to acquire endowments, affected subjects' decisions in different domains. Muehlbacher and Kirchler (2009) found that an effort level could determine the willingness to cooperate within a group. However, the finding contradicts other researchers' results. For example, Spraggon and Oxoby (2009) found that real efforts increased the contribution size compared to those who did not perform any task at all. Whereas, Cherry et al. (2005) did not observe any difference in the contribution sizes among those who did perform a task and those who did not. The main difference between Muehlbacher and Kirchler's experimental design and that of previous researchers was that in other experiments participants were informed about the asymmetry of origins of endowments. Providing such information could have led to "anticipated reciprocity", expectation that the non-earners would contribute more. In order to measure the pure effort effect, Muehlbacher and Kirchler (2009) did not inform the subjects about the diverse origins of group members' endowments. Such approach successfully dealt with part of the problems, however, the design and the implementation of the experiment suffered from several other technical problems: The effort was manipulated by watching a cartoon video under various soundtracks, which could have caused a distraction, annoyance and irritation. Thus, the mood effects could have played a role rather than effort. Moreover, most likely the incentives in the experiment were not high enough to trigger self-interested decision making: endowments 50 ECU = 1.2 EUR, which could have amounted to maximum earning of less than 3 EUR for the group member who had fully defected, while all other group members had fully cooperated. Such poor incentive could be the reason why there was only one defector (contributing zero ECUs).

To fix the above mentioned problems, I paid higher incentives: 50 ECU = 5 EUR. The maximum possible earning was 11.6 EUR. As a results 12.2 % of all 246 contribution decisions were zeros. Besides, in this research, a letter counting task was introduced (inspired by the task from Rey-Biel et al. 2011), which could not have led to any kind of mood effects and required simple routine effort from the students.

The experiment, also advanced the state of research further. To the best of my knowledge, this is the first experiment to analyse effects of creative ef-

fort on cooperation. While the previous literature examined the influence of different levels of effort on cooperation, in the present study, types of efforts were also addressed by employing conceptually different, word creation task (Eckartz et al., 2012). Understanding whether the effort type affects cooperation is very important as in modern knowledge based economies, types of tasks differ in multiple dimensions. The demand for highly creative workers, such as programmers, coders and data scientists are several times higher than available specialists. In addition, such experts often work in small groups. They usually have earned their knowledge with their past, individual creative endeavour. Thus, it is important to know how they possibly feel about cooperating with their peers. Therefore, the current experiment can be considered as the opening of a new horizon for future research in this part of behavioural science.

In line with previous literature it was expected that a higher level of effort would lead to lower cooperation. Earning endowments could have caused reversed sunk cost effect, an increase in risk aversive choices, which in this case was contribution to the public good. Thus, through the "behavioural sunk cost" (Zeelenberg and van Dijk, 1997), subjects could have gotten more attached to their earnings and hesitate to cooperate. The reason behind non-observed differences could be complexity of the Public Goods Game: Even though it was well explained and the PGG calculator (an instrument to ease understanding of the character of the game) was extensively used and positively regarded, participants might have failed to include the endowment effect in a more complex environment, demanding greater cognitive effort and involving simultaneous decisions by other contributors (Cherry et al., 2005). The alternative explanation for non-observed differences in mean contributions is amount of effort exerted by the subjects. Since laboratory experiments usually take on average one hour, it is difficult to imitate the effort levels exerted in real life situations.

In addition, to no significant effects of effort level, no effects of effort type were identified. This could be related to the following factors:

1) The literature which has observed over-valuation of creations - the *creativity effect*, has applied tasks related to arts: writing poems or painting paintings (Buccafusco and Sprigman, 2010, 2011), which are more personal and could have caused more attachment to the artefacts. In psychological creativity literature commonly tasks are open questions, related to diverse topics. The responses are usually analysed by several independent jurors (this method

is called Consensual Assessment Technique). This study applied a different, word creation task for the following reasons: First, it is relatively easy to program and execute in a computer laboratory; Second, no evaluator jurors are needed, which saves substantial amount of time; Third, despite the analysis of correlation among jurors' decisions, estimation of creative performance can still be considered to be subjective (Mohnen and Ostermaier, 2013). In the word creation task, effort levels could be easily manipulated by increasing the threshold of needed points and moreover, it was similar to the routine effort task in many ways: Both tasks were in verbal domain, in both cases participants could have chosen alternative strategies: solve short letter strings/find short words and collect needed points in small increments or solve longer letter strings/find long words and collect needed threshold with relatively bigger increments. One of the important issues could be, that letting the participants know what the exact value (50 ECU = 5 EUR) of their effort was, probably limited the individual interpretation and valuation of their creativity. Eventually there was no room left for the creativity effect to emerge.

2) While in the current experiment participants had to contribute earnings from the creative task, in the previous research subjects had to make decisions on their creations. For example, sell paintings drawn by themselves, sell self-designed scarves, or the self-built origami paper cranes.

3) Eckartz et al. (2012) found that although the word creation task is considered to demand creative effort, it was also enjoyable, entertaining and therefore, the incentives could not increase creative performance on this task. Thus, the enjoyability of the task could have caused additional utility to participants, that in the end counterbalanced the unpleasantness of effort exerted while working on it.

4) It is generally acknowledged that for subjects the environment in a laboratory is often comparable to that during examinations. Therefore, it is logical to assume that participants get a certain level of stress while performing the real effort tasks. The research by von Dawans et al. (2012) showed that the participants who experienced acute social stress, induced by a standardized laboratory stressor, engaged in a substantially more prosocial behaviour (trust, trustworthiness, and sharing) compared to the participants in a control condition. Thus, engaging in a prosocial behaviour in response to stress, functions in an opposite direction compared to endowment or creativity effects, which initially were proposed to lessen social behaviour.[10] As a result,

[10]I am thankful to Mike Farjam for bringing this point to my attention.

the above mentioned stress response could have eliminated the manipulation effect.

5) Another critique of the current project is the manipulation of the effort levels. The high effort could also be interpreted as solving a more difficult task within the same time limit as given for an easy task. For example, adding single figured numbers multiple times or multiplying two, three-digit numbers once, by hand within the same time limits. Although such an approach is interesting, it is relatively complicated to administer, as it may lead to losing experimental control as an experimenter cannot be sure that the participants will manage to solve the task in a given time-frame. A solution could be to invite only specialists of a given task. Therefore, future research can also be focused on investigating how the effort levels affect cooperative decisions of individuals specialized in certain fields.

According to the results, SVO was positively related to the contributions to the public good. This is one more proof of an accuracy of SVO measure for prosocial behaviour. The Big Five personality domain of Extraversion was positively related to the cooperation levels ($p - value < 0.05$). However, unexpectedly Agreeableness was negatively related to contribution size ($p - value < 0.05$). To measure Agreeableness the participants were asked how sympathetic and warm did the participants considered themselves on a scale from 1 to 7. Apparently, those who regard themselves as warm and sympathetic are in fact less cooperative. This could be explained by the social context that was created in the experiment. Not only environmental influences change a person's behaviour, but behaviour is also affected by individual cognition, i.e. how they perceive something evoked by different contexts (Hennessey, 2003, Hoff et al., 2012). In this case, once defectors made low contributions, they might have been inclined to regard themselves as open persons in the Big Five questionnaire, comparatively more open than those who were actually more cooperative. With this, they might have tried to present themselves as agreeable individuals despite their non-cooperative behaviour in the experiment.

To summarize, it can be said that the exerted effort levels, for earning endowments, are not determinants for the chosen cooperation level in small groups. Moreover, the creative type of effort does not change preferred cooperative behaviour. The research has several limitations: first, the effort manipulation took only a few minutes, while in real life individuals invest a lot more effort to earn their wealth. The experiment tested only for the effects of a specific type of creativity, namely verbal creativity. Therefore, further re-

search is needed to increase the effort level needed to earn money, and to check for other types of creative effort to conclude that the creative and innovative effort in general, are not influencing factors for cooperation.

2.7 Conclusion

The contribution of the paper to the literature is twofold: First, the endeavour to replicate findings of already existing research in a cleaner experiment was made by employing the experimental design free of technical problems. The past research found that earning endowments influences contribution decisions. In some cases exerted high effort discouraged prosocial behaviour, and in other cases encouraged it. The results of the present research favour the conclusions made by those who could not observe an impact of efforts on cooperation (Cherry et al., 2005). Secondly, an influence of conceptually different, creative type of effort on contributions was tested in a public goods game. Based on the analysis of the experimental data, it can be stated that there was no creativity effect found in a public goods setting.

In conclusion, further research is needed to account for the problems raised in the discussion section. Longer experiments could remedy some of the problems, also inviting actual creators, such as artists, coders or programmers to the lab would increase external validity. Lastly, if the participants contribute self-created artefacts to the public good there is a higher chance that the creativity effect will influence the social behaviour.

2.8 Appendix

2.8.1 General Instructions

Welcome, Thank you for participating in this experimental study!

This experiment will not be particularly difficult or involve trick questions. You will simply need to follow the instructions as they gradually appear on your screen. The answers you provide will be confidential. During the experiment, you will be asked to make choices. It is therefore important for the success of the experiment that you do not talk to each other and that you read the instructions very carefully. If you have questions during the experiment, please raise your hand. At the end of the experiment, you will receive a payment. The actual amount will depend partly on your choices and partly on the choices of the other participants. If needed, you can use area below for calculations.

100 ECU = 10 EUR

Good Luck!

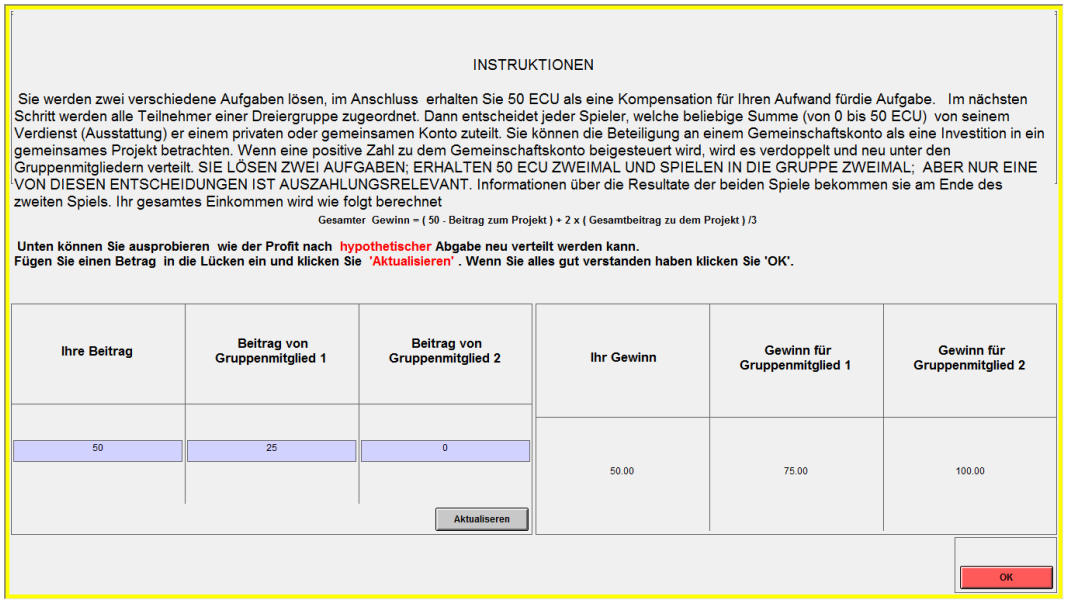
PGG Instructions

You will solve two different tasks; as a result you will receive 50 ECUs as a compensation for your efforts for the tasks. In the next step all participants will be ordered as three member groups. Each player then makes a decision how much of own endowment (from 0 to 50) to contribute to the common account. You can think of the contributions to the common account as an investment in a common project. If any positive amount is contributed to the common account it will be doubled and redistributed among the group members. YOU WILL SOLVE TWO TASKS. YOU WILL RECEIVE 50 ECUs TWICE AND WILL PLAY IN THE GROUP TWICE, HOWEVER ONLY ONE OF THESE DECISIONS IS PAY-OFF RELEVANT. Information about the results on both of these games will be provided in the end of the second game. Your total pay-off will be calculated as follows:

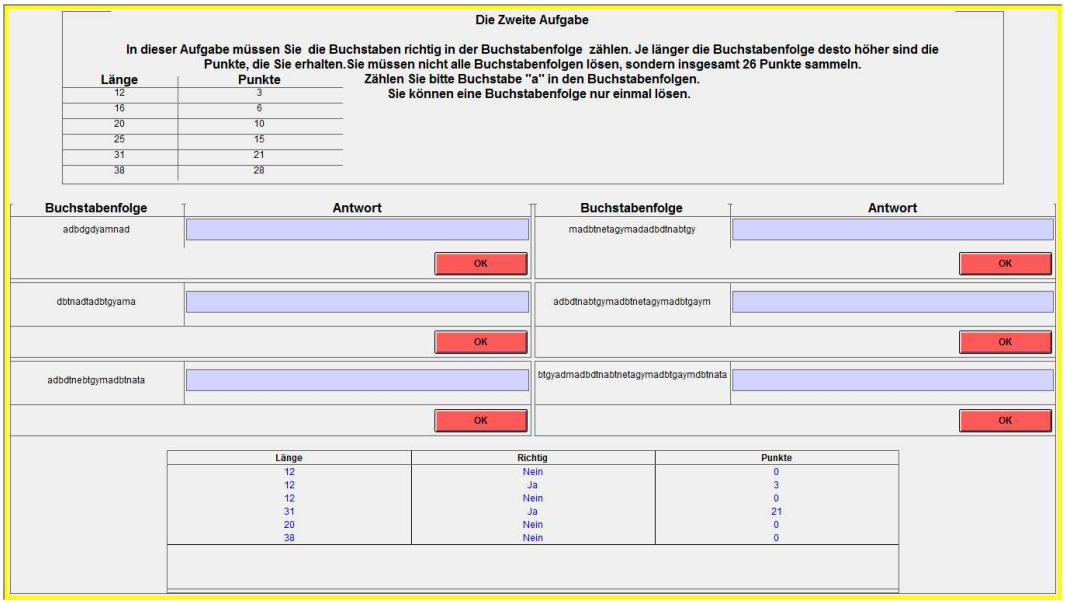
Total Profit = (50 - your contribution to the project) + 2 * (Total contribution to the project) /3

Below you can try out how the profit after the hypothetical contributions can be distributed.

Insert the contributions in the gaps and click 'Aktualisieren'. If you have understood everything well, please click the 'OK' button.



2.8.2 Real Effort Tasks



2.8.3 Contributions: ANOVA and Boxplot

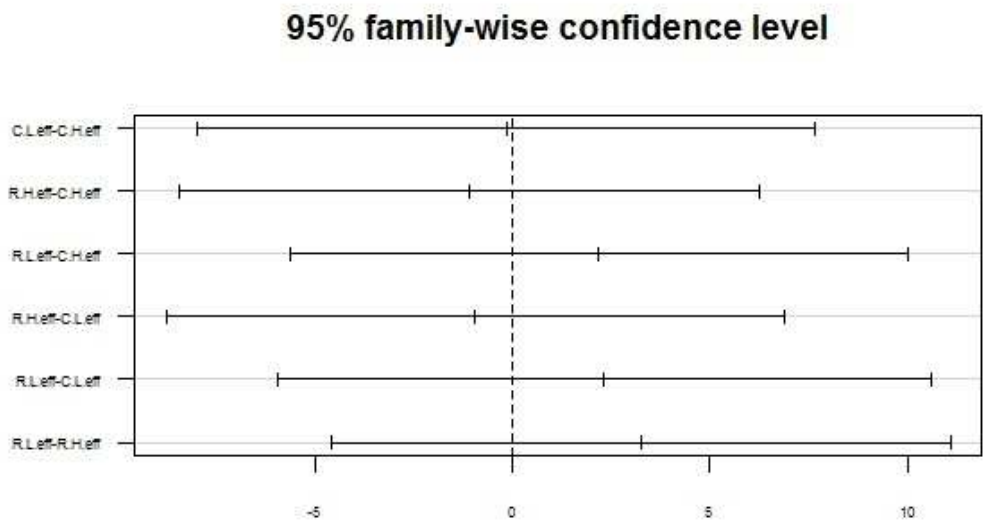


Figure 2.3: Difference in mean contribution levels

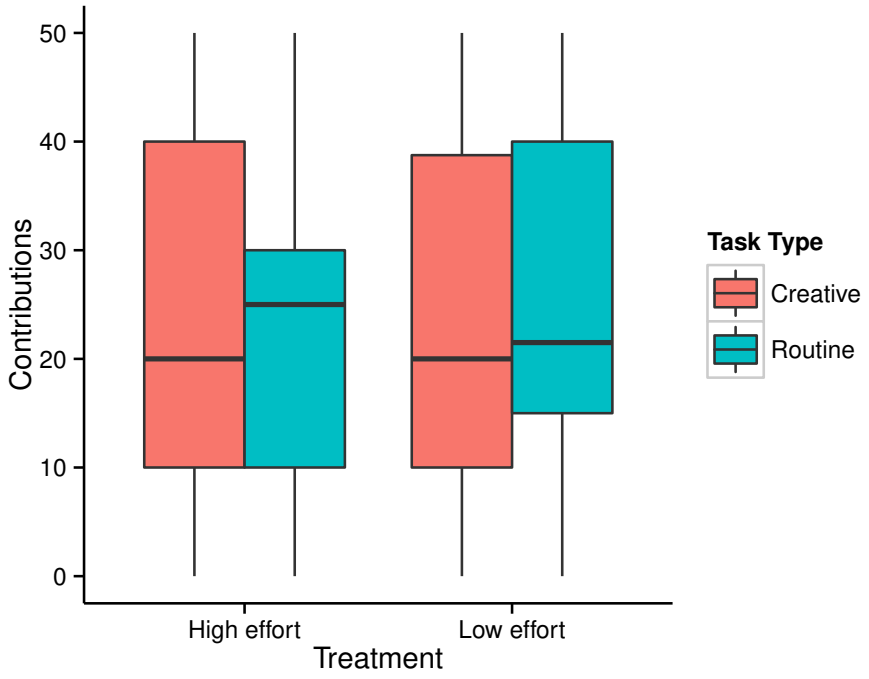


Figure 2.4: Boxplot for contributions across treatments

2.8.4 Correlation Big Five and SVO

	Extra.	Agree.R	Consci.	Emot.R	Open.	Extra.R	Agree.	Consci.R	Emot.	Open.R
Extra.										
Agree.R	0.02									
Consci.	0.19*	-0.09								
Cmot.R	-0.30***	-0.06	-0.02							
Open.	0.31***	-0.06	0.24**	-0.15						
Extra.R	-0.58***	-0.18*	-0.02	0.26**	-0.05					
Agree.	0.22*	-0.15	0.15	0.00	0.23*	-0.06				
Consci.R	-0.18*	0.13	-0.64***	0.06	-0.08	0.12	-0.12			
Emot.	0.34***	-0.11	0.21*	-0.37***	0.17	-0.11	0.21*	-0.19*		
Open.R	-0.14	-0.07	-0.02	0.02	-0.22*	0.04	-0.30***	0.14	-0.08	
SVO	-0.07	-0.10	-0.13	0.07	-0.02	0.14	0.08	0.14	-0.09	-0.01

Notes: *p<0.1; **p<0.05; ***p<0.01
Letter R stands for reversed measure of the personality traits.

2.8.5 Regression Results: Tobit and Logit Models

	Dependent variable:		
	Contributions Routine Task		
	(1)	(2)	(3)
SVO angle	0.408**	0.363**	0.359**
	(0.163)	(0.165)	(0.165)
Extraversion	2.843**		
	(1.397)		
Agreeableness	-3.316**		
	(1.570)		
Conscientiousness	-1.181		
	(1.503)		
Emotional Stability	0.181		
	(1.423)		
Openness	-0.124		
	(1.645)		
Extraversion R.		-0.666	
		(1.229)	
Agreeableness R.		0.293	
		(1.298)	
Conscientiousness R.		1.472	
		(1.329)	
Emotional Stability R.		-1.573	
		(1.325)	
Openness R.		-1.054	
		(1.279)	
Education	0.411	0.604	0.510
	(0.621)	(0.631)	(0.634)
Age	0.896	0.684	0.659
	(0.745)	(0.773)	(0.756)
Gender	-1.484	-1.392	0.212
	(3.992)	(4.147)	(3.919)
Prev. participation	3.483	4.379	3.398
	(4.509)	(4.688)	(4.658)
Task sequence	-3.907	-4.451	-3.707
	(3.811)	(3.846)	(3.864)
Effort level	-1.394	-3.106	-4.070
	(3.896)	(3.900)	(3.849)
Constant	2.202	1.815	-2.357
	(20.690)	(20.053)	(18.163)
Observations	123	123	123
Log Likelihood	-428.701	-430.803	-432.709
Note:			*p<0.1; **p<0.05; ***p<0.01

	Dependent variable:		
	Contributions Creative Task		
	(1)	(2)	(3)
SVO angle	0.377**	0.292	0.295
	(0.190)	(0.193)	(0.192)
Extraversion	2.767*		
	(1.640)		
Agreeableness	-4.550**		
	(1.826)		
Conscientiousness	-0.342		
	(1.749)		
Emotional Stability	0.707		
	(1.662)		
Openness	0.179		
	(1.921)		
Extraversion R.		-0.093	
		(1.442)	
Agreeableness R.		-0.826	
		(1.518)	
Conscientiousness R.		0.821	
		(1.557)	
Emotional Stability R.		-2.172	
		(1.555)	
Openness R.		-1.871	
		(1.514)	
Education	0.176	0.501	0.376
	(0.724)	(0.736)	(0.741)
Age	0.099	-0.152	-0.124
	(0.864)	(0.895)	(0.879)
Gender	-0.728	0.523	1.184
	(4.669)	(4.848)	(4.580)
Prev. participation	7.894	8.780	7.801
	(5.256)	(5.482)	(5.431)
Task sequence	0.495	0.263	0.880
	(4.452)	(4.490)	(4.505)
Effort level	3.268	1.289	0.821
	(4.562)	(4.557)	(4.494)
Constant	12.759	22.336	9.580
	(24.193)	(23.376)	(21.165)
Observations	123	123	123
Log Likelihood	-415.706	-417.925	-419.853
Note:			*p<0.1; **p<0.05; ***p<0.01

	Dichotomized dependent variable:		
	Contributions Routine Task		
	(1)	(2)	(3)
SVO angle	0.067**	0.072**	0.057**
	(0.030)	(0.031)	(0.027)
Extraversion	0.344		
	(0.289)		
Agreeableness	-0.345		
	(0.331)		
Conscientiousness	-0.438		
	(0.409)		
Emotional Stability	0.026		
	(0.244)		
Openness	-0.310		
	(0.344)		
Extraversion R.		-0.160	
		(0.239)	
Agreeableness R.		0.165	
		(0.237)	
Conscientiousness R.		0.242	
		(0.264)	
Emotional Stability R.		-0.226	
		(0.216)	
Openness R.		-0.038	
		(0.231)	
Education	0.012	0.023	-0.007
	(0.118)	(0.109)	(0.102)
Age	-0.153	-0.203	-0.159
	(0.147)	(0.145)	(0.133)
Gender	-0.887	-0.866	-0.496
	(0.782)	(0.777)	(0.686)
Prev. participation	-0.397	-0.040	-0.062
	(0.871)	(0.861)	(0.791)
Task sequence	0.951	0.983	1.008
	(0.770)	(0.789)	(0.735)
Effort level	-1.210	-1.408	-1.571*
	(0.912)	(0.879)	(0.851)
Constant	10.032**	6.663*	5.713*
	(4.802)	(3.782)	(3.268)
Observations	123	123	123
Log Likelihood	-29.112	-30.410	-31.831
Akaike Inf. Crit.	84.224	86.820	79.663
Note:		*p<0.1; **p<0.05; ***p<0.01	

	Dichotomized dependent variable:		
	Contributions Creative Task		
	(1)	(2)	(3)
SVO angle	0.048*	0.048*	0.040*
	(0.025)	(0.026)	(0.023)
Extraversion	0.325		
	(0.229)		
Agreeableness	-0.318		
	(0.268)		
Conscientiousness	-0.234		
	(0.269)		
Emotional Stability	0.109		
	(0.210)		
Openness	-0.140		
	(0.256)		
Extraversion R.		-0.197	
		(0.198)	
Agreeableness R.		-0.084	
		(0.214)	
Conscientiousness R.		0.209	
		(0.219)	
Emotional Stability R.		-0.176	
		(0.197)	
Openness R.		-0.295	
		(0.187)	
Education	-0.118	-0.090	-0.103
	(0.097)	(0.093)	(0.088)
Age	-0.109	-0.144	-0.138
	(0.119)	(0.122)	(0.114)
Gender	-0.704	-0.584	-0.518
	(0.625)	(0.653)	(0.577)
Prev. participation	0.175	0.288	0.248
	(0.671)	(0.734)	(0.652)
Task sequence	1.167*	1.113*	1.171*
	(0.677)	(0.666)	(0.642)
Effort level	0.859	0.531	0.345
	(0.683)	(0.631)	(0.588)
Constant	5.413	6.274**	4.390
	(3.413)	(3.153)	(2.703)
Observations	123	123	123
Log Likelihood	-38.640	-38.275	-40.680
Akaike Inf. Crit.	103.280	102.550	97.360
Note:			*p<0.1; **p<0.05; ***p<0.01

2.8.6 Regressions with Effort Level and Type Dummies

The first table applies Tobit and the second Logit model.

	Dependent variable:		
	Contributions	Contribution R. task	Contribution C. task
	(1)	(2)	(3)
Effort type dummy	-0.548		
	(3.001)		
Effort level dummy		-4.450	1.111
		(3.913)	(4.509)
SVO angle		0.356**	0.351*
		(0.164)	(0.189)
Constant	25.333***	17.773***	14.439**
	(2.118)	(5.550)	(6.396)
Observations	246	123	123
Log Likelihood	-861.089	-434.619	-421.043
Wald Test	0.033 (df = 1)	6.341** (df = 2)	3.449 (df = 2)
Note:			*p<0.1; **p<0.05; ***p<0.01

	Dichotomized dependent variable:		
	Contributions	Contribution R. task	Contribution C. task
	(1)	(2)	(3)
Effort type dummy	-0.324		
	(0.405)		
Effort level dummy		-1.407*	0.214
		(0.812)	(0.369)
SVO angle		0.062**	0.025
		(0.025)	(0.015)
Constant	2.225***	1.726*	-0.810
	(0.304)	(0.896)	(0.528)
Observations	246	123	123
Log Likelihood	-86.867	-33.928	-83.773
Akaike Inf. Crit.	177.733	73.857	173.547
Note:			*p<0.1; **p<0.05; ***p<0.01

Note: Dependent variable "Contributions" includes all contributions regardless of effort level. In models 2 and 3 R. task denotes routine task and C. task denotes creative task.

Chapter 3

Competitive Incentives for Creative and Routine Tasks

3.1 Introduction

One of the main topics of economic research has traditionally been innovation and economic growth. The interest in innovations is understandable as they are recognized to be the main sources of growth on a micro, firm level and also on a macro, national level. Creative idea generation is an initial phase of innovation process. Therefore, analysing creativity has to be one of the central research agendas in economics and psychology. Scientists should invest more effort in exploring ways to facilitate creativity and hence, innovations. Thus, research on how to design economic institutions to achieve highest creative output is of utmost importance (Charness and Grieco, 2014).

One of the key mechanisms to increase employee productivity is believed to be a well tailored payment system. Among different alternatives, competitive incentives are increasingly used in modern organizations. In general, research on competitive incentives and performance is not new (see e.g. Whittemore 1924). However, researchers have found opposite effects of competition on performance. While, for example Calsamiglia et al. (2013) find that competition enhances task performance, Baumeister (1984) and Ariely et al. (2009) show that competition can be detrimental for performance, causing so called 'choking under [competitive] pressure'. As a result of meta analysis of up to 150 research articles Murayama and Elliot (2012) concluded that there is no

noteworthy relation between competition and performance.

Scientific fields such as cognitive and social psychology have considered aspects of creativity since long ago. Probably the first attempt to analyse the effect of competition on creativity was made by Raina (1968). However, there has been less work done on this topic in the economic literature (Charness and Grieco, 2014). Since the beginning of this decade, more and more scholars contribute to the experimental research of creativity and innovations. This method has the potential to contribute to the understanding of how to design payment schemes and incentivize creative output (Brüggemann and Bizer, 2016).

Research findings on creative behaviour and performance are mixed and this is not surprising considering the multidimensionality of creative processes and outcomes. As Jung (1985) put it: "Any reaction to stimulus may be causally explained; but the creative act, which is the absolute antithesis of mere reaction, will forever elude the human understanding. It can only be described in its manifestation; it can be obscurely sensed, but never wholly grasped." (p. 218).

Despite the complexity of the problem, many researchers have addressed the issue by applying experimental methods.[1] There is progress in understanding how incentives may influence creative output. However, some experimental designs suffer technical and methodological problems, others do not include important variables which would have enabled a comprehensive understanding of the treatment effects. Thus, research findings are often contradictory. That is why more research with improved or even new experimental designs are required.

In this paper I analyse competitive incentives for routine and creative performance. Since it is very hard to administer field studies, laboratory experiments are a promising alternative to learn how competition affects task performance. The current laboratory experiment allows one to not only compare a flat payment scheme to a competition condition, but also different levels of competition. The innovative experimental design makes it possible to ask experimental subjects to solve two similar, but conceptually different routine and creative effort tasks. Moreover, I shed light on effects of feedback on performance. Usually it takes time to assess employee performance in companies

[1] See page 7 in Brüggemann and Bizer (2016) for examples on research, applying experimental methodology to innovation and creativity research.

and provide information on individual achievement. In field experiments, it is very difficult to show a ranking and comparative performance of creative workers and probably impossible to have full control over creative production (see e.g. work by Boudreau et al. 2011). In this laboratory experiment, participants learn how good their performance is at a given task while they are still in process of solving it and how their performance compares to that of the leading participant.

The paper is organized as follows: first, I review the literature on incentives for creative task performance. Second, I set the research questions and hypotheses. Then I provide the experimental design, followed by the data analysis and results. Finally, I discuss the results, make implications and conclude.

3.2 Literature Review

In the last years, research on incentives and creativity made substantial progress. Behavioural scientists designed various experiments to learn how incentives for creativity work. A popular idea on creativity suggests that a creative task is inherently appealing and is often done for its own sake (Amabile, 1996). However, in organizational settings individuals usually perform creative tasks for monetary purposes. The previous studies on incentives on creativity have focused on influence of reward size (Ariely et al., 2009), financial incentives for two different types of creativity, "closed" and "open",(Charness and Grieco, 2014) and multitasking and creativity (Laske and Schroeder, 2015).

A growing body of research analyses the influence of different payment schemes on creative performance. However, results are not always in the same line. For example, Eckartz et al. (2012) find that monetary as well as competitive incentives do not affect creative task performance. Erat and Gneezy (2015) compare piece rate and competitive incentive to baseline, flat payment and find that neither type of incentives improve creativity. On the opposite, they show that competitive incentives may have a choking effect and can be even counter-productive. Contrary to that, in their latests contribution to the literature Bradler et al. (2016) argue that competitive incentives are effective and that tournaments substantially increase creative output, with no evidence of crowding out intrinsic motivation.

Although competition and creative performance has been studied by the number of scientists, not much attention has been devoted to analysing effects of different degrees of competition. One example is the contribution by Baer et al. (2010). In their experiment they prove that groups' creative performance increases as intergroup competition level increases from low to intermediate and to high levels. Another research project applied empirical data from quasi-experimental competitions on commercial logo designing. The author found that intensified competition induces agents to explore novel, untested ideas over tweaking their earlier work, but heavy competition drives them to stop investing altogether (Gross, 2015).

Most of the above discussed papers examine incentives for only creative tasks. However, it is also important to analyse a routine task as a benchmark for a creative task. Only a minority of the research papers have analysed these two types of tasks simultaneously. In an experimental study Frey et al. (2013) argue that wage premiums might be motivating for routine task workers, but not for creative workers. Eckartz et al. (2012) suggest that linear payment as well as tournament incentives have very little to no effect on a creative and also on a routine tasks and that differences are mainly driven by individual skilfulness. In contrast, Bradler et al. (2016) find that for both types of tasks, tournament incentives have similar positive effects.

Employing a laboratory experiment Aghion et al. (2014) find that increased competition leads to a significant increase in R&D investments by neck-and-neck firms and that increased competition decreases R&D investments by firms that are lagging behind. Another experiment on innovation contests was done by Brueggemann and Meub (2015). They implement an experiment with a creative effort task and compare a benchmark treatment, without an innovation contest to two different types of contest schemes. In one scheme there was a prize for overall innovativeness and in another scheme the prize was awarded for the best innovation. According to the results, neither of these two contest schemes influenced total innovation activity.

Another interesting aspect for performance under competition is provision of feedback on relative performance. The previous research observed both, positive and negative effects of introducing feedback mechanisms (Liden and Mitchell, 1985, Podsakoff and Farh, 1989). In his theoretical contributions Ederer (2010) concludes that "performance evaluations motivate some employees, but at the same time the information they convey will demotivate other workers and may also reduce equilibrium effort of all workers, in particular, when this

information creates a very uneven playing field between the contestants..."(p. 762). For example, in a simple field experiment Gneezy and Rustichini (2004) show that when schoolchildren participate in a running competition and their performance is calculated by seconds needed to complete the run, they usually try their best. Whereas, if they run next to each other and thus, can instantaneously see their relative performance, the losers quit without even finishing the competition. Aghion et al. (2014) suggest that similar pattern can be observed for creative or innovative actors. As soon as they realize that they will almost certainly lose, laggards quit or disengage from competition and reduce R&D investments. It also has to be mentioned that there are some instances when authors failed to find any effect of feedback. For example, Eriksson et al. (2009) analysed routine performance with piece-rate and tournament incentives with discrete and continuous feedbacks. They find that giving feedback (discrete or continuous) does not significantly influence the average performance in neither the piece-rate nor the tournament pay scheme. Likewise, in recent contribution Wooten and Ulrich (2016) find that there is no discernible difference between direct feedback and no feedback conditions for stimulating performance in innovative task.

Research has also found that some personality traits may affect creativity. According to Klotz et al. (2012) extraversion and openness are unrelated to motivation, but positively related to creative behaviour, while neuroticism and conscientiousness are not associated with creativity, but were positively related to motivation to perform on a task. Thus, taking into account workers' psychological design is also important when assigning different types of tasks and designing various payment schemes.

3.3 Hypotheses Development

Effects of competitive incentives may differ according to what type of task has to be done. A creative task is more cognitively demanding and depends on individual skills as well as chances. These characteristics make creative work uncertain and this can cause choking[2] under competitive pressure (Ariely et al., 2009, Erat and Gneezy, 2015). This usually translates into decreased productivity and performance. This argumentation is related to research by

[2]Compte and Postlewaite (2004) define choking as a physical response to a perceived psychological situation, usually fear of not performing well or failing.

Fershtman and Gneezy (2011), who find that in high powered tournaments there are significantly more quitters.

Routine tasks, on the contrary, do not include uncertainties and are usually well defined, close-end tasks. According to Madjar et al. (2011) a routine task effort usually refers to quantity of task rather than to quality. In other words, routine tasks are usually identified as repetitive mundane activities that are not uncertain, require relatively less cognitive input and can be easily fulfilled by following simple instructions.

Usually when there is a high competition, larger prizes are at stake. The larger stakes on the one hand make the prize more desirable and competition exciting, on the other hand it becomes more stressful. Thus, those who are not confident that they are better than a large amount of competitors are more probable to get choked. This pattern should be similar for creative and routine tasks. In other words, low competition is less likely to lead to choking, but high competition is more probable to reduce performance on the expense of choked, under-performing participants and on the expense of quitters.

Thus, **Hypotheis I and II** can be formulated as follows:

- *Low competition increases routine performance, however high competition decreases routine performance.*
- *Low competition does not affect or only slightly increases creative performance, however high competition decreases creative performance.*

As discussed above, performance on a task can heavily depend on feedback that workers receive. When laggards are informed that they are far behind the winners, they get demotivated and may disengage from the task. Whereas, if the competition is neck-to-neck, individuals should exert maximum effort to surpass the current winner. Those on the top of competition should also stay alert not to lose their position and keep exerting maximum effort. This behavioural response should be similar regardless of the type of the task. Thus, it is expected that in high competition treatments, when the feedback on relative performance is immediately provided, the gap between the winners and the losers will be larger compared to low competition treatments. This also relates to the characteristics of creative tasks. These tasks are uncertain per se and competitive pressure will probably be enhanced for uncertain and complex tasks.

Thus, **Hypothesis III** can be formulated as follows:

- *Providing feedback on individual ranking within a group decrease average performance for both types of tasks.*

In general, females do not perform as good as males under tournament conditions (Croson and Gneezy, 2009, Erat and Gneezy, 2015, Gneezy and Rustichini, 2004, Niederle and Vesterlund, 2011). Therefore, if competitive incentives have a positive impact on performance, such result will be mainly driven by males. Finally, if an individual easily gets nervous and negatively responds to uncomfortable environment she is more likely to under-perform (Maslach et al., 2001). Thus, I formulate **Hypotheses IVa and IVb** as follows:

- *Males respond to competitive incentives more positively than females.*
- *Big Five dimensions of openness and extraversion will be positively associated with both types of performance.*

3.4 The Experimental Design

Procedure and design. The experiment was conducted at the Friedrich Schiller University Jena (Germany). It was computer based and was programmed with Z-tree (Fischbacher, 2007). The participants were recruited using the Online Recruitment System for Economic Experiments (ORSEE) (Greiner, 2015).

The experiment had four treatments (see overview in Table 3.1). The first was a baseline treatment with a flat rate payment of 5 euros for each subject. The second treatment was a low competition treatment. In this condition experiment participants were grouped in three person groups[3] and the best performer won a prize of 10 euros and the losing group members earned only the show-up fee of 2.5 euros. In the third, high competition treatment,

[3]I decided to have three person groups to approximately have the same size of groups as other authors. For example (Eckartz et al., 2012) had four person groups and (Erat and Gneezy, 2015) had two person groups.

participants played in 18 person groups[4] and the best performer won 47.5 euro, while the rest of the participants earned 2.5 euros (see payment schemes in the Table 3.2). The fourth treatment, high competition with feedback, was basically the same as the high competition treatment. The only difference was that the subjects instantaneously received information on their ranking and on what the performance measure of the current winner was. Thus they knew not only their performance and ranking while solving tasks, they also received information which enabled them to calculate the gap between themselves and the winner.

	Routine Task	**Creative Task**
Flat rate	5 euros per subject	5 euros per subject
Low Competition	3 competitors. The best gets 10 euros	3 competitors. The best gets 10 euros
High Competition	18 competitors. The best gets 47.5 euros	18 competitors. The best gets 47.5 euros
High Competition with Feedback	18 competitors. The best gets 47.5 euros	18 competitors. The best gets 47.5 euros

Table 3.1: Experimental conditions.

Each player solved two types of tasks: a routine and a creative task. In the end of the experiment one of these tasks was randomly selected by computer to be pay-off relevant. The subjects were provided full information on the process of the experiment in advance (see instructions in Appendix 3.8.1). That is, they knew that they would have to work on two different tasks and that only one of them would determine how much they earned. Right before the start of the tasks subjects read the task instructions, which explained the rules of the game and provided examples. To cancel out the effect of the task order, i.e. sequence in which subjects solved two different tasks, the sequence was switched in different sessions. To put it simply, some subjects solved the routine task first followed by the creative task and others solved the creative task first, followed by the routine task.

Real effort tasks.

In the routine effort treatments participants counted letters within given

[4]This size of the high competition group was determined by the maximum capacity of the laboratory at the University of Jena.

Rank	**Flat rate**	**L. Comp.**	**H. Comp.**	**H. Comp. Feedback**
1	5	**10**	**47.5**	**47.5**
2	5	2.5	2.5	2.5
3	5	2.5	2.5	2.5
...	...		...	...
17	5		2.5	2.5
18	5		2.5	2.5
Av. Pay.	5	5	5	5
SUM	90	15	90	90

Table 3.2: Payment for subjects in Euros.

strings of letters.[5] For example, subjects had to count how many times a letter "a" and "b" appeared in letter strings with different lengths. The longer the solved letter strings were, the more points subjects received. After the given time (3 minutes for each type of task) was up, they automatically proceeded to the next stage (See figure in Appendix 3.8.2).

As a creative task, I use a word creation task similar to one used by Eckartz et al. (2012). The main reasons for this are that it has many aspects of a creative task and it mimics quite well a creative innovation. Also, it takes less time than other options, it is easy to program, objectively assesses creativity and makes it possible to count efforts exerted and performance achieved by players (see figure in Appendix 3.8.3). Moreover, subjects' ranking can be instantaneously updated and displayed in real time.

Similar to the routine task, the longer the words the participants built, the more points they earned (see Table 3.3). After the given time was up, they automatically proceeded to the next stage. Thus, for both types of tasks performance is measured by the amount of points subjects accumulated in a given task.

One more, supportive argument for using these tasks, is the neutrality of the tasks in terms of gender differences. While for math tasks usually there is a bias in favour of males, for verbal tasks there is less evidence that there are performance differences among males and females (see e.g. Gitelson et al. 1982, Skaalvik and Skaalvik 2004). Therefore, if there is a difference in

[5]The task was inspired by the real effort task designed by Rey-Biel et al. (2011).

	Words from the letter set " a c c d e e e g i n s t "
ad	1 + 2 = 3 points
and	1 + 2 + 3 = 6 points
cats	1 + 2 + 3 + 4 = 10 points
...	...
teasing	1 + 2 + 3 + 4 + 5 + 6 + 7 = 28 points

Table 3.3: Measuring creativity: Longer words generate more points (Eckartz et al., 2012)

performance it can be ascribed to individual skills and decisions to exert effort under different treatment effects.

Another important feature of creativity is that the tasks may be "open" or "closed". The closed creativity implies a solution of a task with a specific and delineated goal, for example, reducing the size of a computer, developing a drug for specific purpose. Whereas open creative tasks do not have ex-ante goals or directions. For example, improve usability of electronic devices or making them more aesthetically appealing. As Charness and Grieco (2014) show, financial incentives are ineffective in incentivizing open creativity. The word creation task is a "closed" task. Application of it in this experiment is also justified from this perspective.

In difficult tasks, people overestimate their actual performances but also mistakenly believe that they are worse than others; on easy tasks, people underestimate their actual performances, but mistakenly believe they are better than others (Moore and Healy, 2008). To put it differently, doing difficult task makes people think they are under-performing, while doing an easy task leads to beliefs that they are over-performing. To avoid this, in the current experiment, the real effort tasks are calibrated so that the difficulty of the tasks are maximally approximated. Different performance responses resulting from such an approach can be assigned to skilfulness and more importantly, to the effects of competition levels.

After completing the second real effort task, the participants answered manipulation questions, asking which task they found more creative, difficult, and requiring higher effort. After that, subjects learned their final performance, their ranking if they were not playing control treatment, and the total pay-off. Finally, they responded on personality and demographic questionnaires. The

personality traits were measured by Ten-Item Personality Inventory (TIPI) by Gosling et al. (2003).

3.5 Results

For statistical analysis and graphs I used R software (R Core Team, 2013).

The experiment was conducted at Friedrich Schiller University Jena, during October-November 2016. In total, 290 subjects participated in the experiment, the majority were students at the University of Jena. I dropped two observations because the participants did not pass the German language test[6] and three more observations, because the participants did not understand the requirements of the tasks. In Table 3.4 I provide the number of observations for each experimental condition. The experiment lasted about 30 minutes and average earning was 5 euros (ranging from 2.5 Euros for those who lost in any of the competition treatments to 47.5 euros for those who won the high competition treatments). 65% of the participants were females. Average age was 25.1 years ($SD = 4.35$).

Treatment	**N of obs.**
"No Competition. R"	73[7]
"No Competition. C"	73
"Low Competition. R"	68
"Low Competition. C"	68
"High Competition. R"	72
"High Competition. C"	72
"Feedback High Competition. R"	72
"Feedback High Competition. C"	72

Table 3.4: N of observation in each condition

Manipulation check. In order to check if the creative task manipulation worked, the students were asked the following question: In comparison to the counting task, did you have a feeling that the word task needed more creative

[6]The experiment was done in German language. In order to make sure that the participants were fluent in German, they took a short language test (developed by Kirchkamp and Reiß 2011).

effort? (The answers could range from 1 = no creative effort to 7 = very high creative effort). On average, response to this question was 5.3, that indicates that students found the word task more creative than the counting task.

In Appendix 3.8.4 I show frequencies of total points collected by students for each treatment and task type. As it can be seen in Figure 3.2 in the baseline treatment, none of the players collected very high number of points and this goes in line with the argument that if a task is routine, mundane, and relatively uninteresting, flat-rate payment will not motivate individuals to exert extremely high efforts. On the opposite, for the creative task, even in the baseline treatment there were participant who worked extensively and collected substantially more points than average (see Figure 3.3). Moreover, it has to be emphasized that in the baseline treatments, for routine tasks, there were more players who collected less than 20 points. These were individuals who decided to shirk. If looking at the right hand tail, in the flat rate treatment very few participants collected more than 250 points while in treatments with competition such performance was more frequent. Lastly, it has to be mentioned that the creative performance distribution is positively skewed,[8] while performance on the routine task is more normally distributed with long tails. This is not surprising, considering the nature of creativity and the fact that only very few individuals can be exceptionally creative.

In Table 3.5 I provide results of t-tests. Test 1 compares the routine performance in baseline and low competition treatments. As predicted in hypothesis I, competition increased routine performance ($p - value < 0.1$). Test 2 shows that the difference was not statistically significant when the baseline performance is compared to performance in the high competition treatment. In test 3 I compare the performance for the low competition treatment participants and the performance in the high competition treatment with feedback. The difference in performance was not statistically significant ($p - value > 0.1$). Test 4 compares baseline and low competition treatments for the creative task. There is no statistical difference. Test 5 and 6 compare performance in the low and high competition treatments with the performance in high competition treatment with feedback. In both cases the difference is strongly significant ($p - value < 0.05$). Figure 3.1 visualizes mean performances across all treatments.[9]

[8]The skewness suggests that it is more appropriate to use Tobit models for the creative task. That is why in Appendix I demonstrate results of both, OLS and Tobit models.

[9]In the figure the bar heights represent mean performance. The bar heights within the same tasks and not across tasks have to be compared. The different tasks are color coded.

	Test for routine task	Results
1	Welch Two Sample t-test:	t(113.73) = -1.79, p = .077.
2	Welch Two Sample t-test:	t(112.76) = -1.55, p = .125,
3	Welch Two Sample t-test:	t(135.61) = 1.14, p = .255,
	Test for creative task	Results
4	Welch Two Sample t-test:	t(137.43) = -0.98, p = .328,
5	Welch Two Sample t-test:	t(123.56) = 2.41, p = .018,
6	Welch Two Sample t-test:	t(131.83) = 2.03, p = .044.

Table 3.5: T-tests

In Appendix 3.8.6 I regress performance on routine and creative tasks on treatment variables. Only low competitive incentives were supportive for routine tasks. As it has been shown by other authors, competitive incentives did not have a significant positive effect on creative performance. In Appendix 3.8.6 I set the low competition treatment as reference point and examine how high competition with and without feedback affected performance. The results show that high competition with provision of feedback had a significantly negative effect on creative performance. This result supports the third hypothesis that if competitors receive information that suggests that they are highly likely to lose, they are will reduce their effort causing a decline in average performance.

Performance by different genders. The hypothesis IVa predicted that males would be more responsive to competition. The data analysis shows that this was the case for the high competition treatment. In Appendix 3.8.5 I show performance across all treatments for males and females separately. While males responded to a high competition environment by significantly increasing routine performance ($p-value = 0.02$), females shied away from high competition. Their performance slightly decreased in comparison to the average performance in low competition (although the effect was not statistically significant $p - value > 0.1$). A similar pattern was observed for the creative performance (however differences were not significant for the creative task). If comparing performance of females and males in high competition treatment, in routine task, males performed better. The difference was significant at $p - value = 0.06$ level (see Figure 3.6 in Appendix).

In the data analysis I include a number of control variables (the regression tables are provided in Appendix 3.8.6). The results suggest that those

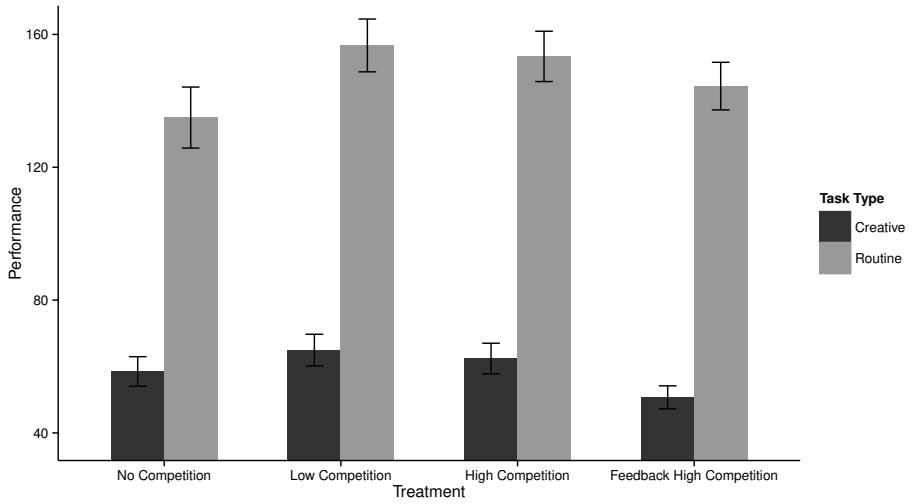


Figure 3.1: Average performance for all treatments

participants who find the creative task requires more effort performed better on routine task and worse on the creative task. The participants who were not native language speakers[10] performed significantly worse and those who like word games in general performed better on both tasks. The older age of participants was also a negative factor for both types of performance. Having participated in similar experiments previously influenced the task performance positively.[11] When the creative task was done first, followed by the routine task, participants performed worse on the creative task. This probably indicates that, even if the tasks were not related, the routine task helped to "warm up" or prepare for the creative task.

Thus, the data provides supportive evidence for hypothesis I and partial support for hypotheses II, III and IVa. Namely, the routine task was incentivized by inducing low competition but not high competition. Creative performance did not significantly increase with introduction of competition. High competition had a positive effect on males and had only slight negative effect

[10]Overall there were 14 foreigner subjects who passed language test. Exclusion of these observations from the data analysis does not change the treatment effects.

[11]For this experiment only those individuals were invited who have not participated in the experiments with used real effort tasks, however 9 subjects indicated that they had taken part in the laboratory experiment with the similar games. Exclusion or these participants from the data analysis does not change the results.

for females. However, competition with feedback was strongly detrimental for the creative task and slightly detrimental for the routine task. In what follows I discuss the results and suggest possible policy implications.

3.6 Discussion and Implications

The previous research findings on competitive incentives for performance are mixed. Scholars have found positive, negative and no effects of competition on creative performance. The competitive incentives were more often found to be conducive for routine tasks. However, the differences in how people respond to competition on two different tasks have not been systematically studied. The majority of the work in this direction considered either routine, well defined tasks or creative, relatively uncertain tasks.[12] This paper analyses the performance on both types of tasks simultaneously. Moreover, the tasks were done by the same individuals, therefore it is legitimate to compare competition effects across the task types.

The first result shows that low competition enhances routine, but not creative performance. This result is in line with previous findings on creative performance (Eckartz et al., 2012, Erat and Gneezy, 2015), that competition is not supportive for creative output. This is probably caused by the main feature of creativity: it requires abstract thinking and usually is intrinsically motivating. People get engaged in such tasks not only for monetary incentives or hoping to get reward, but also because it is interesting and enjoyable to work on such tasks. This is different for the routine tasks. These types of tasks do not generate additional utility and the main motivating factor to do the task is monetary reward.[13] Moreover, the performance on routine task is directly linked to effort. When a worker increases effort it is directly reflected in improved performance. This is different for the creative tasks, because creative tasks are uncertain and require specific set of skills. Therefore, the increased effort is not always linked to higher performance.

[12]The exceptions are recent contributions by Eckartz et al. (2012) and Bradler et al. (2016).

[13]Eckartz et al. (2012) found that competition did not increase even a routine performance. The reason could be that they used Raven's matrices and number adding tasks, which are not totally mundane tasks and unlike the task used in this experiment, they could still be intrinsically motivating.

The second result suggests that high competition did not have an effect on the routine or the creative performance. For the creative tasks this finding can be explained with the same argument as for the low competition treatment. Competition, regardless of it's intensity, cannot be a supportive instrument for the creative task performance. In case of the routine task, high competition had a very small positive effect. However, the effect was also not significantly different from zero.

The third result concerns the effects of the fourth treatment - high competition with feedback. In comparison to the flat payment there was no difference in performance, however when comparing to the low competition performance, high competition with provision of detailed feedback on ranking and position of the leading competitor had a detrimental effect on average performance. The adverse effect is driven by individuals who either quit as they see that there is a very low chance of winning or get anxious as they are losing the game and under-perform.

There is one interesting behavioural pattern when looking at competition and performance: Namely, in the low competition conditions competitors are more likely to have approximately equal points. It is more reasonable if the subjects assume that performance spread is not too large and is rather narrow. Therefore, it is worth to keep exerting maximum effort. However, in high powered tournaments with more competitors, it is more likely that there is a distinct leader who has substantially more points. That is why in low competition conditions the best creative performers exert very high effort. When feedback is provided, leader competitors, able to outperform others easily, keep exerting just enough effort to beat the second best. This observation is somewhat related to the findings of Cantner et al. (2009) and Aghion et al. (2014), who show that in R&D competition, laggard firms are more prone to quitting, whereas those who are in neck-and-neck competition increase R&D investments.

The fourth result on differences in how different genders react to high competition suggests that males respond to high competition more positively. As other scholars have documented (see e.g. Gneezy et al. 2003), I find evidence that males respond by increasing effort when they face high competition. This pattern was especially revealed in the routine task, where, on average, male participants outperformed female ones.

The above discussed results provide some interesting implications for organizational management: 1) When deciding whether to introduce tournament

incentives in a company, managers should distinguish between a routine and a creative task. Those tasks, that are mundane and at the same time can be completed with simple repeated actions[14] can be incetivized by competition. However, the competition should not be too intense, i.e. optimally, few competitors should be assigned to a task and relatively low prize should be provided. In line with previous research, the evidence from this experiment suggests that competitive incentives do not work for creative tasks. Therefore, employers should rather come up with a different reward scheme. 2) If opting for a competition incentives with high prize and a high number of competitors, managers should expect decreased average performance if they provide full feedback on ranking and position of the leading competitor before the end of the tournament. Disclosure of information on status quo of the competition de-motivates laggard competitors decreasing performance. Thus, if a firm is interested in increasing average performance by setting up a high prize tournament, it is better not to disclose information on performance until everyone completes the task. 3) Managers should also consider that there is a difference in how males and females respond to competition. It is more likely that males will be encouraged by high competitive incentives, whereas females are more negatively affected by the intensity of a competition.

Finally, it has to be mentioned that a tournament size and competition intensity has to be adapted with the company size. While in a lab, behavioural scientists are limited with the available space and funds to run experiments, in the real world, companies have much higher number of employees and larger resources to fund tournaments. Nevertheless, authorities in organizations should not ignore the behavioural patterns observed in the laboratory. Although external validity of experimental results are limited, experiments represent the only instrument to control the environment and investigate pure treatment effects. Thus, business practitioners should learn from scientific findings and maybe test the effects with actual employees. Ideally, they can select a representative sample of employees and investigate how competitive incentive change their productivity.

[14] An example of such work is installing wind-shields on cars (see Lazear 2000).

3.7 Conclusions

In this paper I investigate how different levels of competition affect routine and creative tasks. The results suggest that low competition increases routine performance, but does not affect creative performance. As previous work on creativity has observed, creative tasks are usually intrinsically motivating and additional monetary or competitive incentives are less functional. In addition, I examine how the provision of feedback on the current ranking and performance of the leader in the competition affects average performance. As the results suggest, individuals under-perform when they have full information and thus, can realistically assess chances of winning.

The findings suggest that managers can significantly improve employee performance by introducing low competition if the workers have to do a routine task. Moreover, if designing a winner-take-all competitive payment scheme, it is better not to reveal performance of the highest achiever. This way it is possible to avoid discouragement of lagging competitors and decrease in overall performance. Lastly, I find that males respond more positively to high competition compared to females. Therefore, high competition can improve routine performance of males.

Finally, it has to be mentioned that although this paper provides new insights on competitive incentives, it could not cover all possible variations of different payment schemes and different task types. For example, future research should also investigate how feedback affects performance in flat payment and low competition conditions. Besides, this paper researched performance on "closed" creativity, where the number of possible solutions is limited. Future research should shed more light on "open" creative tasks and competitive incentives. Similarly, routine tasks can be mundane, but still be cognitively demanding. Therefore, studying different types of routine tasks is also desirable.

3.8 Appendix

3.8.1 General Instructions

In this experiment you will work on two different types of tasks. As a show up fee you will get 2.5 Euros. You can earn additional money depending on your performance in these games.[15] You will play the games in 3 [18][16] person group. Only if you collect the most points in your group you will get 10 [47.5] Euro prize, otherwise you will earn show up fee! TAKE INTO CONSIDERATION THAT YOU WILL PLAY TWO DIFFERENT GAMES BUT ONLY ONE OF THEM WILL BE RANDOMLY CHOSEN TO BE PAY-OFF RELEVANT. Therefore, you have to collect maximum points in both games. Each game will last 3 minutes. [While playing the task, you will get information about your current performance as well as performance of the best player and your ranking in the group.][17] You will receive the instructions about the rules of the tasks just before starting the tasks. Information on how well you performed and how much you earned will be provided in the end of the second task.

3.8.2 Routine Task Instructions

Counting Task

In this task you have to find letters in given letter strings and put correct figure in the gaps. After each counting you have to click OK button to get feedback whether your response was correct or not and how many points you have. Only if you count letters correctly you get points. The longer strings you solve the more points you get. Here is an example:

Assume you have to count letters "a" and "d" and the letter string is: abcde-abcab

- Correct answer is 4, because there are three times letter "a" and once "d"

In the task your goal is to collect as many points as possible!

[15] In baseline treatment participants were told that they would earn 5 Euros for playing both games and that they could not earn extra money.

[16] In the high competition treatment the number of group members was 18 and prize was 47.5 Euros.

[17] In feedback treatment instructions was same as in high competition treatment. Only difference was that this sentence was added.

3.8.3 Creative Task Instructions

Word task

In this task you are given a letter string with what you have to build German words. You can build small and big words and also prepositions. After building each word you have to click OK button to get feedback whether your response was correct or not and how many points you have. Only if you build real German words you get points. The longer the words you build are, the more points you get. Here is the full set of rules:

Assume you have to build words with a letter string: abcdeabcab

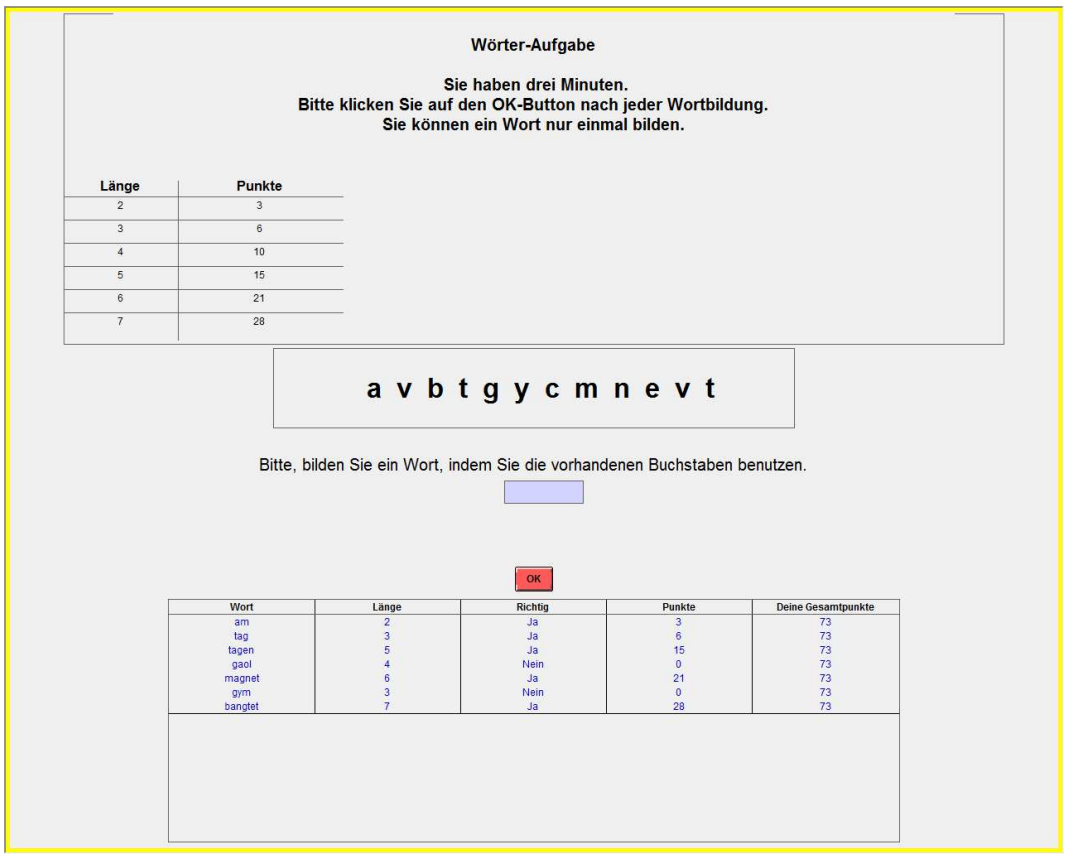
-word "bad" is allowed ;

-word "abbe" is allowed, because there is two “b” in the string;

- word "babe" is NOT allowed, because it is an English word;

-word "baden" is NOT allowed, because there is no letter "n";

In the task your goal is to collect as many points as possible!



3.8.4 Descriptives

Distribution of points in each treatment

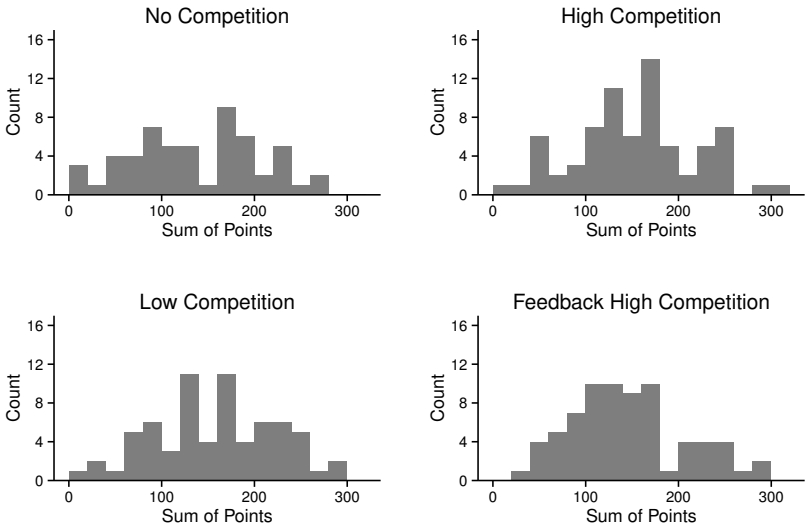


Figure 3.2: Distribution of points for routine task

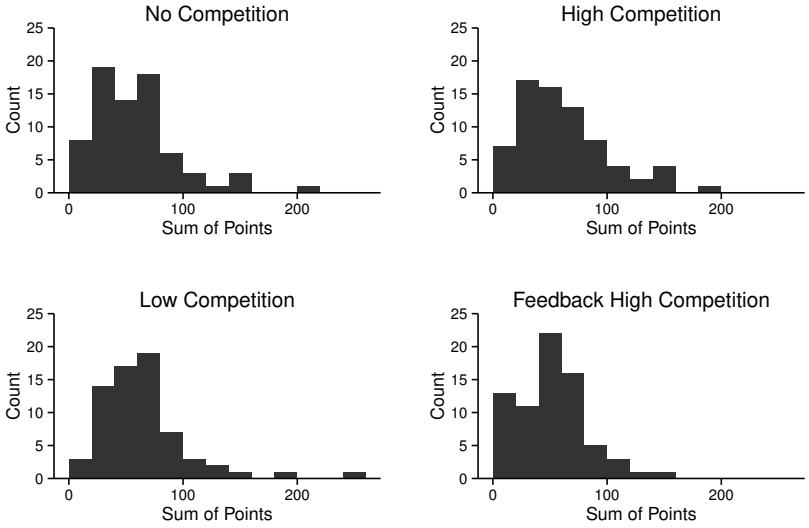


Figure 3.3: Distribution of points for creative task

3.8.5 Average Performance of Different Genders

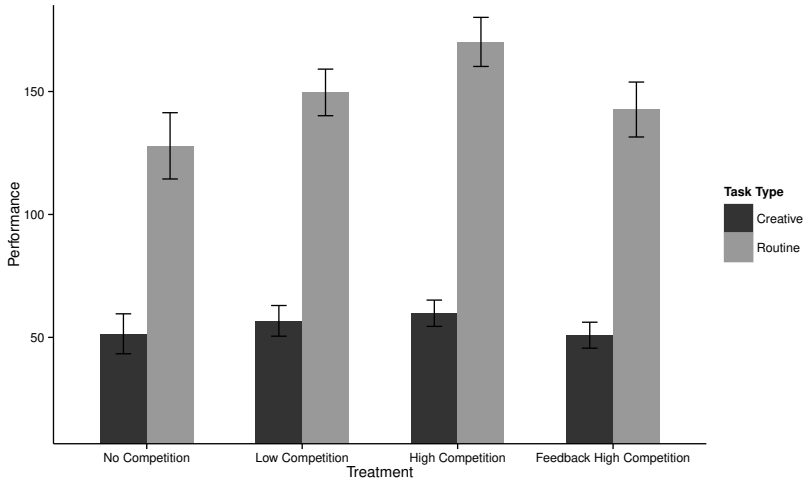


Figure 3.4: Performance of males

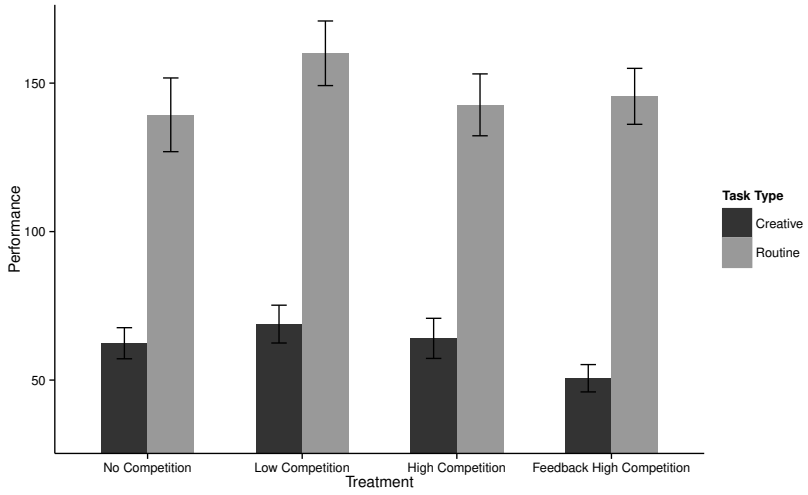


Figure 3.5: Performance of females

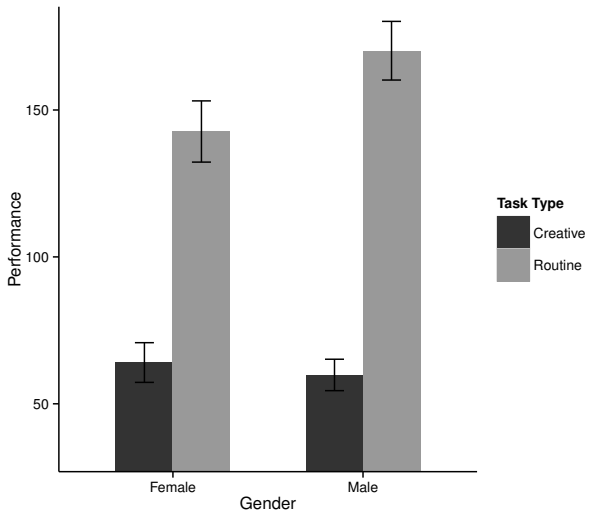


Figure 3.6: Performance under high competition treatment

3.8.6 Regression Analysis

Treatment Effects

	Dependent variable:	
	Routine Performance	Creative Performance
	(1)	(2)
Low Competition	21.713*	6.420
	(11.700)	(6.180)
High Competition	18.411	3.896
	(11.554)	(6.090)
High Competition Feedback	9.467	-7.785
	(11.554)	(6.090)
Constant	134.964***	58.507***
	(8.700)	(4.291)
Observations	267	285
R^2	0.016	0.021
Adjusted R^2	0.004	0.011
Residual Std. Error	64.518 (df = 263)	36.666 (df = 281)
F Statistic	1.398 (df = 3; 263)	2.026 (df = 3; 281)
Note:		*p<0.1; **p<0.05; ***p<0.01

Table 3.6: OLS model

	Dependent variable:	
	Routine Performance	Creative Performance
	(1)	(2)
Low competition	22.139*	6.203
	(11.697)	(6.175)
High Competition	18.538	3.896
	(11.554)	(6.083)
High Competition Feedback	9.893	-8.017
	(11.551)	(6.086)
Constant	134.538***	58.507***
	(8.701)	(4.286)
Observations	267	285
Log Likelihood	-1,482.992	-1,423.101
Wald Test (df = 3)	4.291	6.164
Note:		*p<0.1; **p<0.05; ***p<0.01

Table 3.7: Tobit model

Treatment effects with Low Competition as baseline

	Dependent variable:	
	Routine Performance	Creative Performance
	(1)	(2)
High Competition	-3.301	-2.524
	(10.746)	(6.117)
High Competition Feedback	-12.246	-14.204**
	(10.746)	(6.117)
Constant	156.676***	64.926***
	(7.706)	(4.387)
Observations	212	212
R^2	0.007	0.029
Adjusted R^2	-0.003	0.020
Residual Std. Error (df = 209)	63.546	36.176
F Statistic (df = 2; 209)	0.702	3.111**
Note:		*p<0.1; **p<0.05; ***p<0.01

Table 3.8: OLS model

	Dependent variable:	
	Routine Performance	Creative Performance
	(1)	(2)
High Competition	-3.592	-2.311
	(10.718)	(6.126)
High Competition Feedback	-12.246	-14.221**
	(10.715)	(6.129)
Constant	156.676***	64.714***
	(7.684)	(4.395)
Observations	212	212
Log Likelihood	-1,176.345	-1,054.280
Wald Test (df = 2)	1.393	6.290**
Note:		*p<0.1; **p<0.05; ***p<0.01

Table 3.9: Tobit model

Regressions with control variables: OLS and Tobit models

	Dependent variable:	
	Routine Performance	Creative Performance
	(1)	(2)
Found C.task Effortful	12.689***	-2.993**
	(2.722)	(1.384)
Found C.task Difficult	0.513	-1.885*
	(2.180)	(1.120)
Found C.task Creative	-2.763	-1.330
	(2.413)	(1.215)
Extraversion	-5.382	1.905
	(3.481)	(1.788)
Agreeableness.R	2.847	1.637
	(2.683)	(1.371)
Conscientiousness	0.306	1.785
	(3.406)	(1.754)
Emotional Stability.R	-5.738*	-1.581
	(3.243)	(1.656)
Openness	1.872	-0.380
	(3.576)	(1.810)
Extraversion.R	0.166	-0.417
	(3.023)	(1.564)
Agreeableness	-0.908	0.654
	(3.760)	(1.903)
Conscientiousness.R	-1.732	1.189
	(3.116)	(1.588)
Emotional Stability	-0.721	-0.065
	(3.192)	(1.634)
Openness.R	1.847	2.512*
	(2.903)	(1.485)
Age	-2.088**	-0.933*
	(0.961)	(0.500)
Not Native Speaker	-37.318**	-31.129***
	(17.695)	(9.233)
Gender	1.118	-5.524
	(8.660)	(4.437)
Education	0.736	0.594
	(1.156)	(0.593)
Previous participation	22.818	30.005***
	(22.029)	(11.536)
Task sequence	9.052	-13.358***
	(8.508)	(4.445)
Liking word games	6.687**	3.280**
	(2.996)	(1.515)
Freq. word games	4.475	7.481***
	(3.980)	(1.986)
Low Competition	13.822	9.709*
	(11.661)	(5.722)
High Competition	8.136	12.911**
	(11.860)	(5.861)
High Competition Feedback	-2.091	-2.891
	(11.768)	(5.805)
Constant	126.420***	49.574**
	(48.589)	(24.449)
Observations	267	285
R^2	0.197	0.313
Adjusted R^2	0.117	0.250
Note:		*p<0.1; **p<0.05; ***p<0.01

	Dependent variable:	
	Routine Performance	Creative Performance
	(1)	(2)
Found C.task Effortful	13.052***	-3.004**
	(2.617)	(1.330)
Found C.task Difficult	0.617	-1.939*
	(2.089)	(1.076)
Found C.task Creative	-2.928	-1.338
	(2.315)	(1.167)
Extraversion	-5.549*	1.951
	(3.335)	(1.718)
Agreeableness.R	2.829	1.668
	(2.572)	(1.317)
Conscientiousness	0.082	1.755
	(3.266)	(1.686)
Emotional Stability.R	-5.592*	-1.602
	(3.108)	(1.591)
Openness	1.792	-0.420
	(3.425)	(1.740)
Extraversion.R	0.050	-0.387
	(2.899)	(1.503)
Agreeableness	-0.860	0.731
	(3.602)	(1.829)
Conscientiousness.R	-1.806	1.151
	(2.985)	(1.527)
Emotional Stability	-0.762	-0.107
	(3.057)	(1.570)
Openness.R	1.783	2.461*
	(2.781)	(1.429)
Age	-2.411**	-0.927*
	(0.961)	(0.480)
Not Native Speaker	-36.601**	-31.099***
	(16.955)	(8.869)
Gender	1.399	-5.756
	(8.309)	(4.265)
Education	0.799	0.581
	(1.110)	(0.569)
Previous participation	24.077	30.079***
	(21.124)	(11.082)
Task sequence	9.033	-13.430***
	(8.149)	(4.272)
Liking word games	6.717**	3.264**
	(2.870)	(1.455)
Freq. word games	4.671	7.520***
	(3.814)	(1.908)
Low Competition	14.134	9.553*
	(11.181)	(5.499)
High Competition	8.135	12.998**
	(11.374)	(5.630)
High Competition Feedback	-1.959	-3.045
	(11.283)	(5.579)
Constant	134.197***	49.933**
	(47.160)	(23.486)
Observations	267	285
Log Likelihood	-1,455.022	-1,372.674
Wald Test (df = 24)	66.812***	129.657***
Note:		*p<0.1; **p<0.05; ***p<0.01

Chapter 4

Effects of Constraints on Routine and Creative Performance

4.1 Introduction

Scientists have defined creativity in many different ways. Authors have even contributed book chapters and scientific articles to the discussion of what is a true meaning of creativity (e.g. Amabile 1996, Ford and Harris 1992, Runco and Jaeger 2012). However, most frequently creativity is understood as a production of novel and at the same time, useful ideas (see e.g. Amabile 1988).

Creative work is usually viewed as the first step or ingredient for innovation (Madjar et al., 2011). It is often associated with free streams of ideas and efforts, which lead to discovering new solutions that are both original and practical, or in the domain of arts, aesthetically appealing. The products of creative thinking are supposed to increase value by combining old materials in a different, unconventional way or applying new materials in an old, commonly accepted way. In fact, when it comes to actual work, within an organizational framework, creators are expected to achieve certain goals and produce solutions with specific features.

Managers and organizational leaders often assign tasks that are not routine. They require certain types of solutions, but there is no simple guideline on

how to reach the required specifications. Under such circumstances, outcomes below the predetermined threshold may have very little or no value. In such cases, one can speak of constraints for a given task. Here, with constraints I mean setting clear performance demands and not reimbursing task solutions with below threshold performances. Thus, principal decision makers have to decide whether to impose constraints or not.

Rationally speaking, solutions which do not add value should not be rewarded. That means, managers should set constraints, demanding certain types of solutions and not rewarding those employees who did not reach the required minimum. However, this kind of approach may not always be optimal.

In this paper I investigate how imposition of constraints affect routine and creative task performance. Responses to constraints may differ depending on types of tasks. To the best of my knowledge, there is no research done, which integrates the analysis of constraint effects on these two types of tasks in a single study. Moreover, research done on constraint degrees and creative performance is very limited and the results from those few contributions are not unequivocal. Therefore, I design an experiment to investigate what are the effects of different levels of constraints on routine as well as on creative task performance.

In what follows, I first review the literature on performance and constraints. Second, I formulate the research questions and hypotheses, followed by description of the experimental design in detail. Then, I provide the experiment results. Finally, I discuss the results, offer theoretical and practical implications and conclude.

4.2 Literature Review

The notion of constraints is not uncommon in psychological creativity literature. It appears in seminal works of leading scientists, who claim that there are important relations between creativity and constraints (see e.g. Amabile 1996, Johnson-Laird 1988, Kaufman and Sternberg 2010). Some of them go even further asserting that without constraints there can be no creativity (Onarheim and Biskjaer 2013, Stokes 2005).

It often is believed that creative work needs freedom to generate diverse, novel and useful ideas (see e.g. Amabile 1979, 1996, Crutchfield 1962, Koestler

1964, Rogers 1954). In her seminal book Amabile (1996) describes how great creative minds, such as Einstein, Picasso and Woody Allen suffered and escaped from constraints. In addition, Amabile writes that autonomy in creative thinking process fosters creativity. She argues that giving people freedom in how they approach their work heightens their intrinsic motivation and sense of ownership. Freedom about process also allows people to make use of their expertise and their creative thinking skills. In this way, the task may seem to be difficult, but individuals can use their competence to meet the challenge (see Amabile 1998, p. 82).[1]

However, the growing interdisciplinary literature on constraints and creativity questions this belief. The majority of research contributions approach this subject theoretically, providing various hypotheses based on case studies and mere observations of few instances. However, there are some empirical and experimental papers worth mentioning. (In Appendix 4.8.1 I provide a list of some studies focussing on creativity and constraints in various research fields).

Constraints on creativity can be diverse. They can be restrictions on inputs, i.e. resources (Moreau and Dahl, 2005), on time (Amabile, 1998, Baer and Oldham, 2006, Karau and Kelly, 1992), on skill and finances (Hoegl et al., 2008, Scopelliti et al., 2014) or on outputs. The latter may relate to demands on final products (Ward et al., 2002) or goals (Peterson et al., 2013) of creative processes.

For example, Onarheim (2012) classifies constraints in six different dimensions:

1. timing (initial to late);
2. flexibility (non-negotiable to negotiable);
3. importance (nice to have to must have);
4. source (e.g. user, subject, client, personal, task);
5. domain (e.g. internal, external, domain, inherent);
6. purpose (e.g. validity, non-functional, quality).

[1]It has to be mentioned that Amabile does not totally reject the fact that some level of constraints might be beneficial for creative outcomes.

More generally, Kaufman and Sternberg (2010) suggest that creativity may reside in a person, a process, a product or a place. Therefore, constraints may stem from these loci.

From an imposition perspective, constraints can be classified in three categories: intrinsic (inherent in the material), imposed (by external agents client), and self-imposed (initiated by the creative agent himself in expectance of a higher creative pay-off) (Elster, 2000). While the self-imposed constraints are usually used in arts, externally imposed constraints are more common in engineering and technology. Moreover, engineers refer to constraints as requirements,[2] while in art domain, for example in poetry, requirements are regarded as 'genre conventions', stating what is allowed to be done (Onarheim and Biskjaer, 2013). In the current project, I externally impose constraints on experiment subjects and hence, the manipulation can be perceived as setting rules on what an employee in an innovative firm is allowed to do.

For the purposes of this paper I use the definition of constraints as limitation or restriction for what can and what cannot be done in problem solving, and for what the final solution should fulfil (see Lombardo and Kvålshaugen 2014, p.3 and Onarheim 2012, p.324).[3] Thus, I model the type of constraint that externally permits or prevents certain creative solutions for a given task.

Some authors (see e.g. Burroughs and Mick 2004, Moreau and Dahl 2005) have shown that constraints may positively affect the extent of creative processes. A relatively small body of research has explored a curvilinear relation between creative performance and constraints (see e.g. Baer and Oldham 2006, Liikkanen et al. 2009). Moreover, most of these works have focused on time pressure as an impediment or a facilitator of creative solutions. Therefore, further research has to be done on other types of constraints to improve general understanding and links between constraints and creativity.

Below I focus on some of the scientific contributions which applied experimental methodology to investigate relations between creativity and constraints.

[2]Constraints as requirements should not be mixed with *creative requirements* which are perceptions that one is expected, or needs, to generate work-related ideas. Being a perception, creative requirement is the experienced, psychological aspect of both explicit requirements (e.g., being told to be creative) and other cues (e.g., as a response to task demands) (Unsworth et al. 2005).

[3] See Amabile 1978 for early work on effects of extrinsic constraints.

In their experiment, Amabile and Gitomer (1984) placed schoolchildren under behavioural constraints. They had to make collages using a subset of a large array of materials. Half of the children could use the materials they wished, the other half had to use only those that were preselected by the experimenter. Collages were judged by a group of artists. According to the results, the unconstrained choice was conducive to creativity.

In a similar experiment Moreau and Dahl (2005) ask experimental subjects "to design a toy, anything a child (age 5-11) can use to play with". They were provided with a subset of 20 different shapes, parts to use for designing. Authors manipulated two types of constraints. 1) Input restrictions: component parts were chosen either by participants or experimenters and 2) input requirements: participants could use as many parts as they wanted or they were required to use all five parts. The creativity of the final products was assessed by expert judges. The results show that the subjects produce significantly more creative toys when they were restricted in both ways. That is, they had to apply all component parts and were required to use preselected shapes.

Another relevant experiment was conducted by Joyce (2009). In her experiment she asks subjects to come up with creative products related to the health industry. In a low constraint treatment participants were asked to address any issue related to the general topic of health. The moderately low constraint prompt asked them to solve any of five subtopics related to health. The number of subtopics listed was reduced to three in the moderately high constraint prompt, and finally, there was only one subtopic in the high constraint prompt. The experiment had two phases: Research phase and proposal writing phase. The results confirmed that moderate constraints may play a supportive role and be conducive for creative performance. However, there are few technical issues related to experimental design: This way of manipulating constraints is somewhat problematic. Asking to do research and choose a topic requires much more search time than directing individuals to find information on particular types of products. Moreover, performance on writing a proposal on a single specific type of product may very much depend on idiosyncrasies of the products and the availability of information on the web. The data analysis proved that the time spent on the research phase was significantly and negatively correlated to creative performance.

To summarize, research findings are mixed. Some authors have observed negative, some positive and others rather curvilinear links between constraints

and creative performance.

4.3 Research Questions and Hypotheses

Most of the recent scientific literature on creativity and constraints suggests that restriction does not always lead to decreased creative performance. While shortage of resources such as finances or time are more likely to be detrimental for performance in general, some types of constraint for creative tasks, such as requirements, that could also serve as guidelines to solutions, might serve as facilitators. Thus, my first research question is:

1) Do constraints impair or enhance task performance?

Intuitively constraints should have an adverse impact on creative task performance, since creative thinking is often associated with breaking existing rules and merging knowledge in a novel and useful way. Therefore, requirements and demands to subjects should impair freedom and decrease creative performance. However, as some authors have shown, moderate restrictions can in fact help to improve solutions. The right amount of complexity may lead subjects to feel challenged and improve their performance.[4] Thus, I formulate **hypothesis I** as follows:

- *Creative performance will be curvilinearly related to task constraints.*

According to Madjar et al. (2011), routine performance refers to the quantity of work. Therefore, restrictions on routine task can be interpreted as increased quantitative demands, rather than qualitative. Unlike creativity tasks, routine tasks do not include uncertainty about implementation. Thus, urgency pressure emerges from demands to meet certain goals by repeating mundane activity. In situations when uncreative solutions are needed, constraints usually are linked to increased amount of boring and straightforward effort. Therefore I expect that high levels of constraints should hinder routine performance. Hence, **hypothesis II** can be formulated as follows:

- *Routine performance will be negatively related to task constraints.*

[4]See KEYS Scale of Assessing Environmental Stimulants to Creativity (Amabile, 1996).

Emotions can also be constraining factors for creativity (Yang and Hung, 2015). For example, some personality traits, especially openness to experience may have a moderating effect and support creativity (Baer and Oldham, 2006, Xu et al., 2016). Thus, the second research question is:

2) How do previous experience and personality traits affect routine and creative performance?

Previous experience and attraction to tasks are usually positively linked to creative activity. Creators often work on creative solutions as ends rather than means to achieve extrinsic goals, such as earning money (Amabile, 1996). Since subjects usually come to laboratories for earning extra money, I expect that lab incentives will not have a crowding out effect and will rather amalgamate with intrinsic interests in the creative task. Thus, **hypothesis III** can be formulated as follows:

- *Previous experience and liking the task will be positively related to creative performance.*

In line with Baer and Oldham (2006) I conjecture that certain personality traits may positively influence creative task performance. Finally, as **hypothesis IV** it can be stated:

- *Openness to experience and extraversion will be positively related to creative task performance, but not to routine task performance.*

4.4 The Experimental Design

Procedure and design. The experiment had three treatments: No constraints, Low constraints and High constraints, with two types of tasks, routine and creative. Thus, there were 6 conditions (see Table 4.1). Each participant of the experiment worked on both types of tasks of the same treatment, i.e. no, low or high constraints treatment. In order to eliminate task order effects, the sequence of the tasks were switched for some subjects. That means, some individuals worked on the routine task first and then on the creative task, while others worked on the creative task first and then on the routine task. The number of observations for the reversed sequence treatments were mostly

balanced. (In the Table 4.2 NCnst1, LCnst1 and HCnst1 denote observations for the treatments where subjects solved the routine task first. NCnst2, LCnst2 and HCnst2 denote observations where subjects solved the creative task first.)

	Real-effort task	**N of obs.**
Treatment "No Cnstr. R"	Build letter permutations	33
Treatment "No Cnstr. C"	Build English words	33
Treatment "Low Cnstr. R."	Build letter permutations	34
Treatment "Low Cnstr. C"	Build English words	34
Treatment "High Cnstr. R."	Build letter permutations	31
Treatment "High Cnstr. C"	Build English words	31

Table 4.1: Experimental conditions

	NCnst1	**NCnst2**	**LCnst1**	**LCnst2**	**HCnst1**	**HCnst2**
N of obs.	18	15	16	18	7	24

Table 4.2: Number of observations in different sessions with varied sequence of tasks

After entering the laboratory, subjects were seated and informed about the basic rules of participation in the experiment, such as prohibition to use cellphones and to talk to each other. Then, they were told that the instructions of the game are provided on the computer screens and they are self explanatory. After starting the experiment, students read the general instruction on the computer screens (see Appendix 4.8.2). After reading the general instructions they could proceed to the real effort task instructions. This varied depending on which treatment and which task sequence they were participating in.

The real effort tasks.

Creative Task. In this experiment I used two conceptually different types of tasks. While authors in psychological and economic creativity research have applied a wide variety of real effort tasks, it has been proven that tasks which require juries to assess performance are cost inefficient and despite usually observed correlations between the jurors, the estimates can still be considered as subjective (Mohnen and Ostermaier, 2013). Therefore, I apply a word

creation task, used by Eckartz et al. (2012). In this task, participants have to create words from letters. For the purpose of the experiment, I call this task as 'Word Task'. The longer the words participants create are, the more points they receive (see Table 4.3). Their goal is to accumulate as many points as possible. The task participants had to build words out of a random set of letters.[5] The most frequent definition of creativity is generation of novel and useful ideas or recombination of ideas into new ideas (Amabile, 1996). Thus, in this task "materials" (letters) are combined to create new "products" (words), which are semantically more than the sum of the materials. The task allows different solutions, which vary in creativity, because participants can combine letters into any word rather than find one single solution (Mohnen and Ostermaier, 2013). In addition, this task is time efficient, compared to other possible options. Each task took three minutes. It is also easy to program and objectively assesses creativity. Moreover, the task makes it possible to assess the performances of the players in real time and provide immediate feedback on performance (see Figure 4.4 in Appendix).

Routine Task. I wanted to have a task which would be sufficiently similar to the creative task, but would not require creative thinking. Thus, for the routine task, students are asked to build permutations of letters from the same set of letters as for the creative task. Thus, the task was about writing different combinations of letters using a given set of letters. In this case, accepted solutions were mere combination of materials and did not have an added semantic value. This task resembles a paragraph typing task, where subjects had to type a specific paragraph without making mistakes (see Dickinson 1999). I call this task a 'String Task'. The longer the permutations that participants built were, the more points they received. The points were awarded using the same score system as for the creative task. Since the string task was significantly easier, based on pilot sessions, I decided to set conversion rates for the word task: 100 Points = 1 US Dollars and for the string task: 300 Points = 1 US Dollars. After each task participants received information about their earnings for the task. In the end, the computer randomly chose one of the tasks to be pay-off relevant.

Constraint Manipulations.

[5]The letter set used was the following: 'a e e i o u l n m s s r'. The maximum number of words that can be built with this letter set is 1503 and maximum number of points that can be accumulated using this letter set is 26 720. Source: http://www.wineverygame.com/
See number of words and points for each solution length in table 4.6 in Appendix.

In a baseline, control treatment there were no restrictions or requirements on solutions. The main rule for the Word Task was that the solutions had to be English words from the English dictionary and for the String Task, strings had to use only letters from the given letter set.

I manipulated constraints by asking subjects in treatment groups to build words or strings using a minimum required number of letters. In case of low constraints, solutions with a minimum of four letters were needed, whereas for the high constraint treatment subjects had to submit solutions with a minimum length of six letters.

Once the subjects finished the first task, they proceeded with demographic questionnaires and responded to a short personality questionnaire (TIPI, by Gosling et al. 2003).

The experiment was programmed in programming languages Python and Javascript and conducted on the Google Chrome browser. Participants were recruited using Cloud-based Participant Management Software (SONA).

	Words from the letter set " a c c d e e e g i n s t "
ad	1 + 2 = 3 points
and	1 + 2 + 3 = 6 points
cats	1 + 2 + 3 + 4 = 10 points
...	...
teasing	1 + 2 + 3 + 4 + 5 + 6 + 7 = 28 points

Table 4.3: Measuring creativity: Longer words generate more points (Eckartz et al., 2012)

4.5 Results

For statistical analysis and graphs I used R software (R Core Team, 2013).

The experiment was conducted at Rady School of Management Incentives Lab, at the University of California, San Diego (UCSD) in May-June 2016. In total 109 subjects participated in the experiment. I dropped 7 observations

because of technical problems[6] and 4 observations because those participants did not read/understand the instructions. All participants were students of UCSD. The experiment lasted 30 minutes and the average earning was 8 US Dollars (With the range from 5 USD to 12.8 USD). 63% of the participants were females.

Manipulation check. To check if the creativity task manipulation worked the students were asked to indicate to what degree (from 1 = strongly disagree to 7 = strongly agree) they agreed or disagreed with the statement "The word building task requires more creativity compared to the string task". On average students rated creativity on 5.45 level out of maximum 7, this confirms that the word task required more creative effort, compared to the string task.

Treatment manipulation was effective for the high constraints treatment, but was less effective for the low constraint treatment. Subjects who faced no constraints built correct words with an average length of 4.2, those who had low constraints built words with a mean length of 4.6 and those with high constraints built words with the length of 6.2. A similar pattern can be observed for the string task (see Figure 4.1 below). However, it has to be mentioned that in low and high constraint treatments the percentage rate of mistakes compared to the baseline condition gradually increased (see Table 4.8 in Appendix). This suggests that although experiment subjects were exerting effort, constraints caused more mistakes and therefore, the exertion of more unproductive effort.

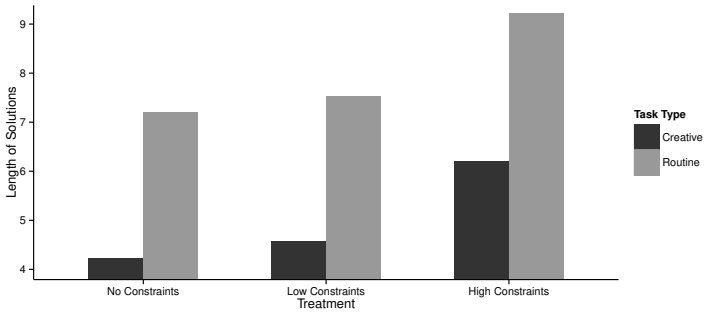


Figure 4.1: Average solution lengths

[6]These 7 subjects accidentally pressed the backward button on the browser that restarted the task. This means that these participants could have used a few additional seconds for the task.

Appendix 4.8.4 shows frequencies for sum of points collected by subjects. For both types of tasks the imposition of constraints caused a decline in performance. Namely, in the constraint treatments, a higher number of subjects were performing worse than in the no constraint condition. These translated in significant decline in average performances (see Figure 4.2).[7]

Table 4.4 provides t-tests. Test results 1 and 2 compare mean points for the routine tasks. Tests results 3 and 4 compare mean points for the creative task. Average accumulated points are marginally less in low and high constraint treatments for routine tasks. However, the difference is significant for the creative task ($p - value < 0.05$). Appendix 4.8.7 provides regression analysis. The results are the same for both, OLS and Tobit models.[8] They suggest that constraints were impediments and significantly worsened performance of the participants.

	Test for Routine Tasks	Results
1	Welch Two Sample t-test:	t(54.80) = 1.89, p = .065,
2	Welch Two Sample t-test:	t(55.02) = 1.17, p = .246,
	Test for Creative Tasks	Results
3	Welch Two Sample t-test:	t(64.80) = 2.23, p = .029,
4	Welch Two Sample t-test:	t(44.48) = 5.39, p < .001.

Table 4.4: T-tests

Thus, when looking at all the data, supportive evidence for hypothesis I was not found. There is no curvilinear relation between constraints and creative performance. Introduction of even low constraints negatively effected creativity. As expected, in support of hypothesis II, constraints were detrimental for the routine task performance as well.

Performance by minutes. Since learning the constraints could have taken some time, I analysed performance of the experiment participants for each minute (see Appendix 4.8.5). In the first minute, the performance on the creative task was worse for the constraint group in comparison to the unconstrained group. However, the situation changed in the second minute. Once the constraint treatment subjects learned the requirements they performed

[7] In the figure the bar heights represent mean performance. The bar heights within the same tasks and not across tasks have to be compared. The different tasks are color coded.

[8] Experiment participants could collect only positive number of points. Therefore, Tobit model is censored at zero.

as good as the subjects without constraints. The difference in performance for the second minute is not significantly different from zero. Finally, in the third minute, the difference between the constrained and unconstrained group re-emerges. This could be ascribed to the constrained group running out of solutions, which led to decreased performance.

Regression analysis by minutes (see Appendix 4.8.9) confirms that for the creative performance low constraints had a negative effect only in the first and the third minute. The coefficient for the second minute is still negative, however it is not significant ($p - value > 0.1$). For the Routine performance the results are somewhat different. Experiment subjects in the low constraint treatment performed worse in the first two minutes, however, they did as well as the unconstrained group in the third minute. Finally, high constraints were detrimental for both types of tasks.

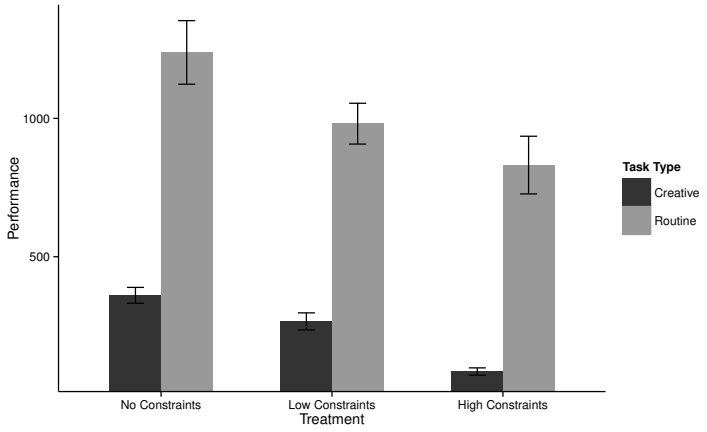


Figure 4.2: Average performance

Appendix 4.8.8 I provides quantile regressions. The analysis studies how the distribution of outcomes are shifted with different levels of constraints. I present quantile regressions for 25th, 75th and 95th percentiles of the distribution of outcomes. The results show that for both, routine and creative tasks, the upper tail of performance gradually shifts downward in a low constraint treatment. The coefficients are not significant for 25th percentile, however it becomes significant with higher percentiles. This indicates that the constraints affected those who would have collected a high number of points. In

case of high constraints, coefficients are always significant and the negative effect increases with high percentiles.

The analysis of the most creative solutions shows that the subjects built the longest words when they faced constraints (see Table 4.7 in Appendix). In other words, if the subjects are asked to build longer words then they are most likely to come up with the longest ones. This result is not surprising and goes in line with what rational theory would have predicted: Subjects will build the longest words in treatments where the longer words are incentivized.

Regression analysis shows that those subjects who found tasks difficult actually performed worse. Those, who considered the word task to demand high creative effort also performed on average worse. Being an English native speaker and good knowledge of English were both positive factors for the word task performance, however, not for string task performance. Experience with word games was not indicative of better performance.

As predicted in Hypothesis IV, personality trait, extraversion was positively related to creative performance, but not to the routine task performance.

4.6 Discussion and Implications

The results for the whole data go in line with the finding of the researchers who confirmed the negative relationship between constraints and performance. In order to observe improved performance for the constraint treatment groups in the experiment, I imposed very low level of constraints for the second, Low Constraints treatment. This was proved by the manipulation check, that shows that in control treatment subjects built on average only slightly shorter words compared to those in the low (4 letters) constraint treatment. The significant decline in performance emerged because of the reduced number of correct solutions for the low constraint manipulation.

The high constraints treatment, which required submission of solutions with the length of 6 or more letters appeared to be extremely difficult for experiment participants. As a result, creative performance decreased by the factor of three in comparison to the low constraints group. Decrease in performance was less prominent for the routine task. However, there is a clear trend that imposition of high constraints hurt both types of performances.

I have analysed the performance for each minute of the experiment and found the following pattern: For the creative task, performance of the low constraint group was as good as for the unconstrained group only in the second minute. This suggests that, it took some time to learn the task, incorporate the constraints and requirements of the task. Once the subjects have achieved that, they were as good as unconstrained subjects. However, this improved performance could not be sustained in the third minute. It seems that subjects ran out of correct solutions which fulfilled the minimum four-letter-length requirement. Thus, in the third minute performance for the constrained subjects worsened again.

In case of the routine task, performance across minutes was somewhat different. In the low constraint treatment, subjects could do as well as the unconstrained group only in the third minute. That means, for the routine task, it took longer to learn the constraint and improve performance compared to first minute. This could happen because despite the fact that the task was routine, required simply typing different combinations of letters, it was also a novel task, a task that is not common and the subjects have never done it before. Lastly, the high constraints had adverse effects for both types of tasks for each minute.

The results for the minute-by-minute analysis offers a few interesting implications: 1) Managers of firms, where employees perform creative or innovative tasks, can expect that there will be a worsened performance in the first phase of imposition of constraints or requirements. Once the workers learn how to deal with the constraints they will perform as well as the others. 2) Managers of a firm where employees work on routine tasks should anticipate that learning and improvement on constraints could bear adverse effects on performance for a longer period of time, especially if they do not have experience or are not familiar with the task. 3) Imposition of high constraints worsens performance so much that managers shall not expect improved performance neither in the short and medium, nor in the long period of time.

As already mentioned above, the fact that the longest creative solutions were found in the high constraint treatment is not unexpected. When asked to build words with the minimum length of six letters, it is more likely that subjects will come up with eight-letter-long solutions. However, there still is an important managerial notice: If principal agents care about the most creative solutions rather than high average creativity, then constraints are presumably the best strategy to achieve the goal.

Reversed measure of Big Five personality trait, extraversion was negatively related to creative performance. In other words, those who are not extraverse were performing worse on a creative task. This suggests that when it comes to creative assignments, managers should pay attention not only to technical skills and experience, but also to personalities of employees. Individuals who are not sociable, eager to communicate with others may be less able to handle creative tasks.

The most striking were the results about the number of correct solutions with the length of 4 letters and more. The imposition of even low constraints decreased the number of correct solutions so much that unconstrained subjects' correctly submitted solutions with the length of 4 or more exceeded that of the constrained group's solutions. To put it differently, in addition to solutions with length 3 and less, unconstrained subjects came up with more solutions with the length of 4 and more (954 solutions) than the constrained group (735 solutions). Thus, ignoring small, with 3 letters and shorter solutions, the unconstrained group built almost 30 % more solutions, which had 4 or more letters .

This result raises the following question: What should company management do when it needs solutions with a certain threshold or specifications? Should it reimburse solutions which are below threshold? Rationally, paying for something that is useless is wrong, but as the results show it may still make a lot of sense. Imposition of constraints blocks simplified thinking which can serve as a basement for more sophisticated solutions. Constrained individuals are forced to directly provide comprehensive solutions. Since complex solutions usually lead to more errors this approach may get quite time consuming. In comparison, when employees still get moderate reward for below threshold results, they do not hesitate to fail in reaching the desirable outcomes initially. Thus, I think that tolerance of failure and even rewarding it may increase overall creativity. This point is crucial and deserves further experimental analysis.

To summarize, looking at all participants, constraints had adverse effects for routine and creative task performance. However, after examining development of the performance over time, I find that low constraints actually may not hurt the performance of the participants. Previous research findings are mixed. With the current findings, I add new evidence which demonstrates that constraints at least, at some stage of implementation may not be harmful. Namely, when individuals get an experience and know how to deal with the quality demands imposed by management they will be able to handle them

once they get used to it.

4.7 Conclusions

In this paper I examined how constraints influence routine and creative performance. The results suggest that in general, constraints are detrimental for both types of tasks. While low constraints have relatively mild negative effect on performance, as expected, regardless of the task type, high constraints always have a strongly negative impact on performance.

The paper also researched performance during different phases of the tasks. In the creative task, after learning the constraints and gaining experience, subjects performed as well as unconstrained ones. Whereas, for the routine task, a marginal improvement in the low constraints treatment appeared in the last minute of the experiment. Surprisingly, the number of correct solutions in the unconstrained treatment, with the length required in the constrained treatment, exceeded number of correct solutions in the constrained treatment. In other words, constraints led to significantly fewer correct high quality solutions.

These findings call for future research to investigate how performance develops over time with the introduction of constraints. It is also very important to know whether a so called build-up of inventions (i.e. learning from one's own ideas) takes place in creative tasks. It could be a major reason causing constraints to have detrimental effects. In a follow-up study I check if experiment participants actually improve on their own ideas. More importantly, I study what role does task specific skills play when low constraints are imposed.

4.8 Appendix

4.8.1 Studies on creativity constraints

Discipline	Author(s)
Psychology	(Amabile and Gitomer 1984, Knoblich et al. 1999) (Ward et al. 2002)
Marketing	(Burroughs and Mick, 2004, Moreau and Dahl, 2005)
Management	(Joyce, 2009, Martinsons and Brivins Martinsons, 1996)
Engineering	(Maiden et al., 2004, Onarheim, 2012)
Computer games	(Bogost, 2007)
Software development	(Maiden and Robertson, 2005)
Linguistics	(Nida, 1998, Tin, 2012)
Nursing	(Bellman et al., 2003)
Sports	(Hristovski et al., 2011)
Art	Stokes (2005)
Music	Kao (1997)

Table 4.5: Literature on constraints and creativity.

4.8.2 Instructions

General Instructions

Welcome and thank you for participating in this study! All the answers you provide are confidential.

In this experiment, you will be asked to complete two tasks, one after another. In one of these tasks you will be asked to create *English words (Word Task)*, and in the other task you will be asked to create any *arbitrary permutation of letters (String Task)*.

At the end of the experiment you will receive $5 for having completed the experiment. In addition, the computer will randomly select one of the two tasks, and we will pay you based on your performance in that selected task.

The method we use to determine your earnings is subtly different between the tasks. Before each task we will describe in detail how your payment is determined. Please make sure that you read the instructions carefully to avoid any misunderstanding. Each task is expected to take less than 4 minutes to complete.

Please click below when you are ready to proceed to the instructions for the first task.

String Task Instructions

String Task

Please read the instructions carefully before starting on the current task. Depending on your solutions, you will receive points.

And for every 300 points that you obtain by the end of the task, you will receive $1.

In this task you will be given 3 minutes to come up with as many strings as you can that use only a specific set of letters.

The longer the strings that you build, the more points you get.

Note that any permutation of the letters that we provide will be awarded points.

The actual set of letters you have to work with, and the points you receive for different strings lengths are given on the next page.

Before clicking below to proceed, please read the full set of rules below.

- You may use only the letters in the set that we give you. For instance, if the set of letters we gave you is A, E, E, L, B then strings
  - the string ALB is allowed (since the set has letters A, L and B);
  - the string AAL is not allowed (since the string has two As and the set only has one A);
  - the string AEE is allowed (since the string and the set both have two Es).
- With the letters we provide, you may build small strings or large strings.

- Just repeatedly building the same strings will not get any additional points.

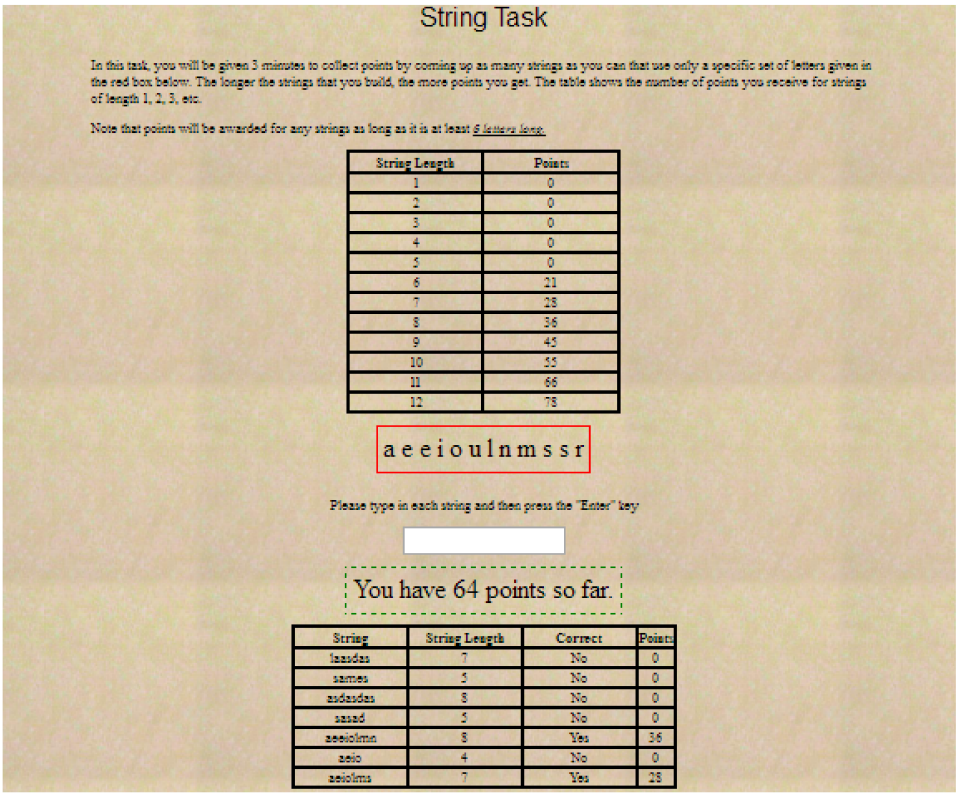


Figure 4.3: Example of a routine effort task

Word task instructions

Word Task

Please read the instructions carefully before starting on the current task. Depending on your answers, you will receive points.

And for every 100 points that you obtain by the end of the task, you will receive $1.

In this task you will be given 3 minutes to come up with as many words as you can that use only a specific set of letters.

Longer words receive more points compared to shorter words.

Note that only the words that we identify as coming from a commonly used English language dictionary will be awarded points.

The actual set of letters you have to work with, and the points you receive for different words lengths are given on the next page.

Before clicking below to proceed, please read the full set of rules below.

- You may use only the letters in the set that we give you. For instance, if the set of letters we gave you is A, E, E, L, B then words
  - word ALE is allowed (since the set has the letters A, L, and E);
  - the word BELL is not allowed (since the word has two Ls and the set only has one L);
  - the word EEL is allowed (since the word and the set both have two Es).
- With the letters we provide, you may build small words or large words.
- Just repeatedly building the same words will not get any additional points.

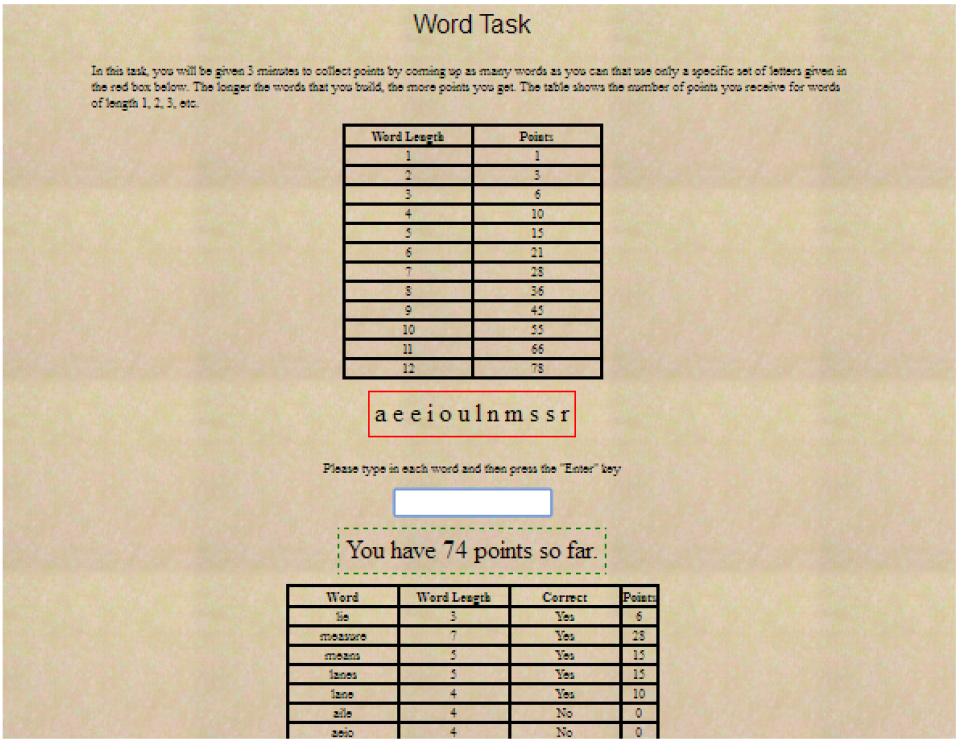


Figure 4.4: Example of a creative effort task

4.8.3 Word task specifications

In the table number of words for all possible word lengths are provided.

Word length	Number of words(s)
11	1
10	3
9	22
8	86
7	203
6	334
5	389
4	309
3	122
2	38

Table 4.6: Word length and number of words.

4.8.4 Descriptives

Distribution of accumulated points across treatments.

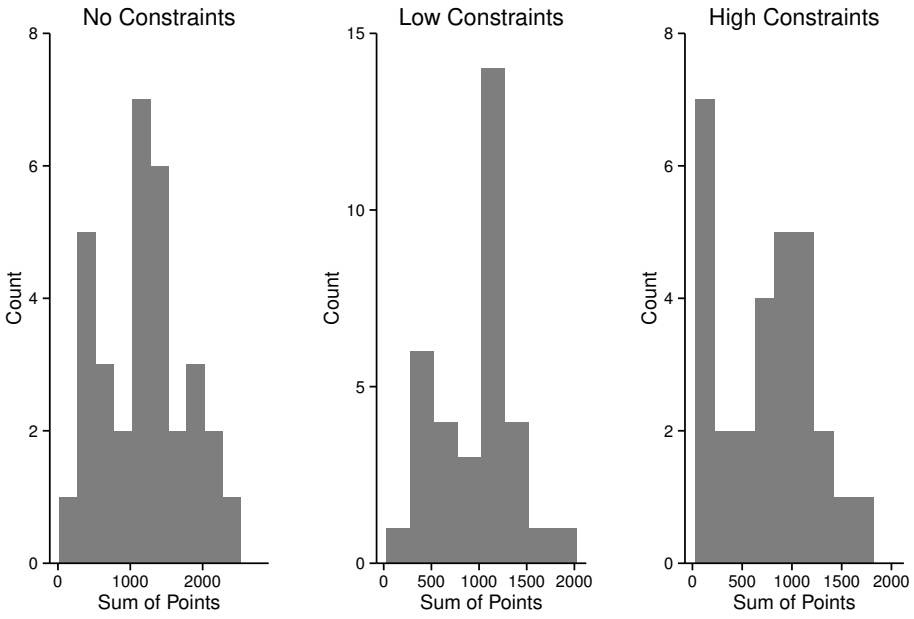


Figure 4.5: Distribution of points for routine task

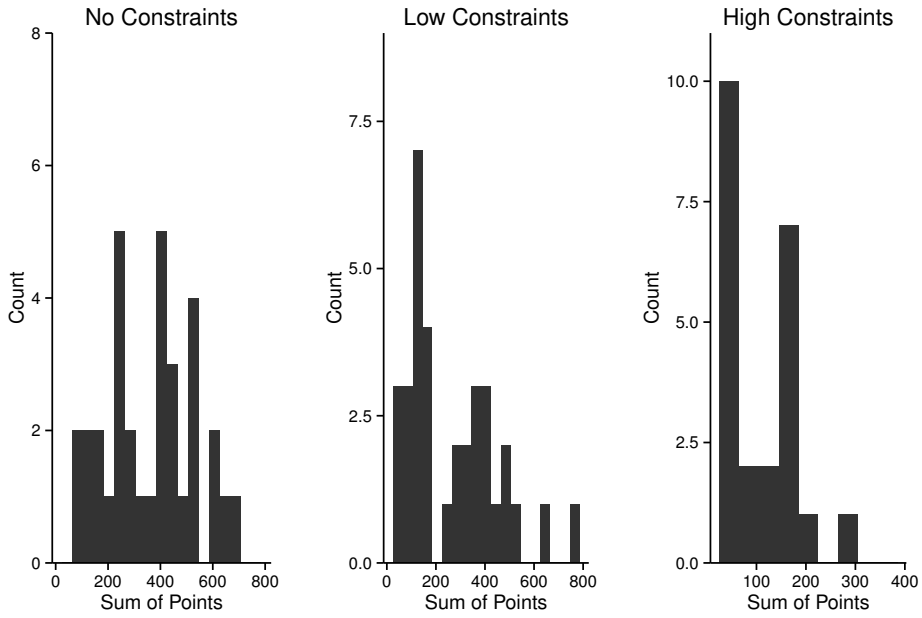
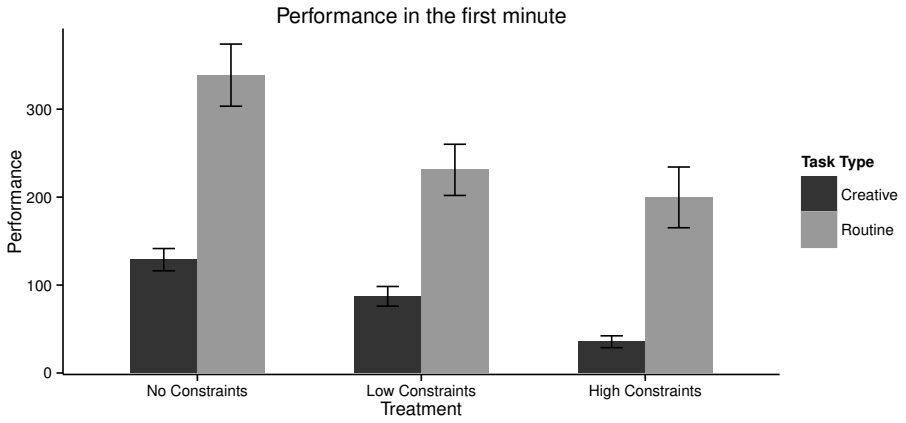
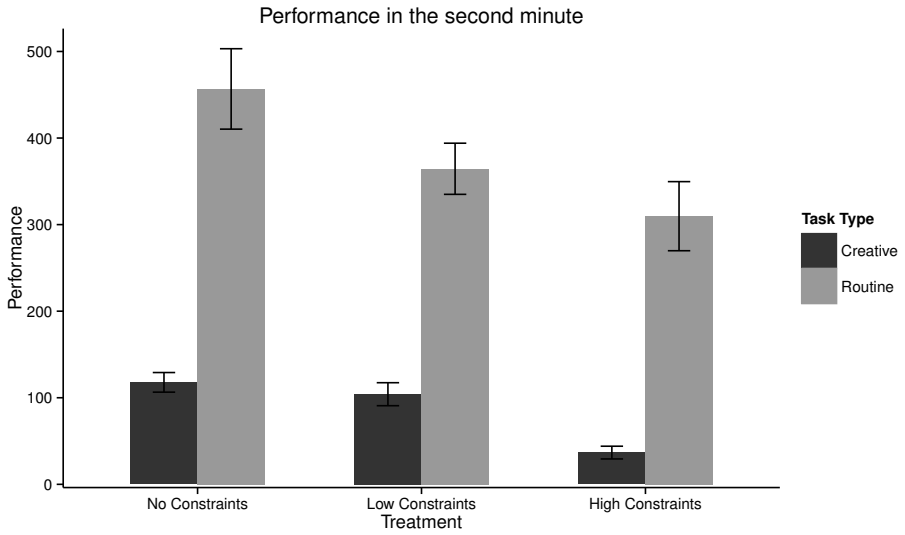
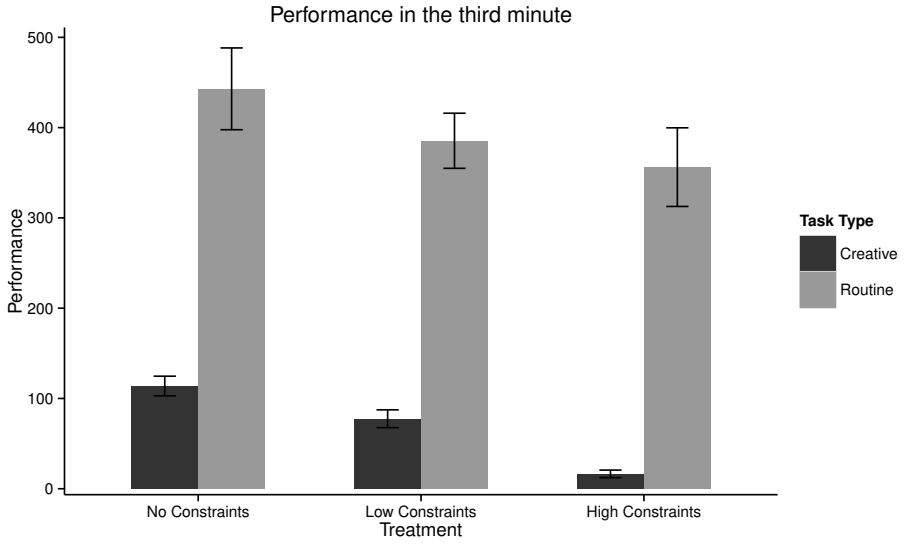


Figure 4.6: Distribution of points for creative task

4.8.5 Performance by minutes




Performance in the second minute
Performance
500
400
300
200
100
0
No Constraints
Low Constraints
High Constraints
Treatment
Task Type
Creative
Routine


Performance in the third minute
Performance
500
400
300
200
100
0
No Constraints
Low Constraints
High Constraints
Treatment
Task Type
Creative
Routine

4.8.6 The longest solutions and letters used for the creative effort task

	Absolute terms			Percentages		
Length of the words	**>5**	**>6**	**>7**	**>5**	**>6**	**>7**
Treatment "No Cnstr. C"	64	12	0	6.11%	1.15%	0 %
Treatment "Low Cnstr. C"	65	15	1	9.27%	2.14%	0.14%
Treatment "High Cnstr. C"	117	25	2	100%	21.37%	1.71%

Table 4.7: The longest solutions across treatments

	N. of letters used	% of useless letters
Treatment "No Cnstr. C"	5893	25.39%
Treatment "Low Cnstr. C"	4701	32.08%
Treatment "High Cnstr. C"	2285	68.14%

Table 4.8: Total letters used and share of letters used in wrong words.

4.8.7 Regression Analysis: OLS and Tobit models

	Dependent variable:	
	Routine Performance	Creative Performance
Word task_diff	70.498	-21.716**
	(43.243)	(10.290)
String task_diff	-99.902***	6.296
	(34.804)	(8.282)
Found task creative	34.050	-22.473**
	(37.732)	(8.979)
Native speaker	215.886	145.256***
	(140.698)	(33.481)
English knowledge	36.568	26.689*
	(61.929)	(14.737)
Freq. word games	138.805	-2.892
	(91.528)	(21.780)
Liking word games	4.076	8.256
	(51.337)	(12.216)
Risk seeking	-42.448	1.855
	(46.644)	(11.100)
Extraversion	16.000	-10.575
	(30.770)	(7.322)
Agreeableness.R	-23.319	-6.562
	(34.904)	(8.306)
Conscientiousness	39.716	23.493**
	(44.501)	(10.590)
Emotional stability.R	-6.682	-6.704
	(40.248)	(9.577)
Openness	47.763	6.595
	(45.740)	(10.884)
Extraversion.R	-20.652	-21.252**
	(33.824)	(8.049)
Agreeableness	10.577	3.142
	(38.680)	(9.204)
Conscientiousness.R	-11.587	7.392
	(34.658)	(8.247)
Emotional stability	-11.261	1.569
	(36.680)	(8.728)
Openness.R	26.580	-3.457
	(34.899)	(8.305)
Gender	58.424	-10.613
	(130.215)	(30.986)
Sequence	59.030	-28.415
	(113.267)	(26.953)
Low Constraints	-333.448**	-82.788**
	(142.483)	(33.906)
High Constraints	-601.967***	-263.291***
	(162.655)	(38.706)
Constant	344.197	339.884**
	(597.029)	(142.071)
Observations	98	98
R^2	0.439	0.688
Adjusted R^2	0.274	0.597
Note:		*p<0.1; **p<0.05; ***p<0.01

	Dependent variable:	
	Routine Performance	Creative Performance
Word task_diff	70.498*	-21.435**
	(37.830)	(9.240)
String task_diff	-99.902***	5.087
	(30.447)	(7.557)
Found task creative	34.050	-23.531***
	(33.008)	(8.030)
Native speaker	215.886*	148.838***
	(123.085)	(30.021)
English knowledge	36.568	31.437**
	(54.177)	(13.393)
Freq. word games	138.805*	-2.488
	(80.070)	(19.472)
Liking word games	4.076	4.601
	(44.911)	(11.028)
Risk seeking	-42.448	1.380
	(40.805)	(9.897)
Extraversion	16.000	-10.016
	(26.918)	(6.539)
Agreeableness.R	-23.319	-6.418
	(30.535)	(7.535)
Conscientiousness	39.716	24.077**
	(38.930)	(9.454)
Emotional stability.R	-6.682	-4.342
	(35.209)	(8.719)
Openness	47.763	7.582
	(40.014)	(9.719)
Extraversion.R	-20.652	-21.983***
	(29.590)	(7.199)
Agreeableness	10.577	5.721
	(33.838)	(8.276)
Conscientiousness.R	-11.587	8.593
	(30.320)	(7.411)
Emotional stability	-11.261	3.882
	(32.088)	(7.890)
Openness.R	26.580	-3.975
	(30.530)	(7.442)
Gender	58.424	-16.846
	(113.915)	(28.275)
Sequence	59.030	-32.128
	(99.088)	(24.085)
Low Constraints	-333.448***	-84.169***
	(124.647)	(30.228)
High Constraints	-601.967***	-279.922***
	(142.294)	(35.161)
Constant	344.197	309.058**
	(522.291)	(128.236)
Observations	98	98
Log Likelihood	-734.172	-573.306
Wald Test (df = 22)	76.603***	213.758***
Note:		*p<0.1; **p<0.05; ***p<0.01

4.8.8 Quantile Regressions

	Dependent variable:		
	Routine Performance		
	(q25)	(q75)	(q95)
Word task_diff	42.821	125.742***	92.730
	(28.546)	(47.086)	(87.374)
String task_diff	-175.610***	-124.514**	15.138
	(18.568)	(52.329)	(84.605)
Found task creative	6.788	14.161	2.440
	(23.299)	(37.662)	(74.356)
Native speaker	13.779	213.882	640.090**
	(119.550)	(211.659)	(303.479)
English knowledge	88.280*	15.035	-221.346
	(50.169)	(100.625)	(172.497)
Freq. word games	174.243**	-21.250	84.406
	(71.200)	(132.543)	(176.606)
Liking word games	-27.600	89.573*	54.211
	(35.766)	(49.303)	(66.476)
Risk seeking	-48.038**	-146.147	-113.438
	(22.429)	(91.561)	(119.087)
Extraversion	30.229	37.125	38.613
	(18.956)	(45.520)	(58.312)
Agreeableness.R	-22.487	-8.467	25.085
	(20.602)	(41.744)	(92.382)
Conscientiousness	-2.766	-43.276	-70.473
	(28.673)	(78.511)	(129.699)
Emotional stability.R	18.272	55.944	89.326
	(24.464)	(68.541)	(55.607)
Openness	72.482**	-47.335	82.911
	(28.867)	(73.142)	(118.486)
Extraversion.R	35.941**	-70.839	-83.561
	(17.817)	(51.220)	(86.773)
Agreeableness	-15.783	91.455	-34.845
	(22.646)	(64.541)	(97.789)
Conscientiousness.R	7.575	-40.803	-51.982
	(27.818)	(44.220)	(61.662)
Emotional stability	-38.712	25.134	161.047**
	(35.008)	(59.395)	(64.169)
Openness.R	-10.161	90.071**	-1.207
	(22.679)	(45.092)	(89.781)
Gender	66.905	-3.216	212.358
	(62.685)	(196.554)	(218.006)
Sequence	86.475	210.898	224.267
	(74.400)	(200.012)	(151.588)
Low Constraints	-140.430	-325.407*	-789.699**
	(94.078)	(191.824)	(348.843)
High Constraints	-438.243***	-649.134***	-1,317.480***
	(100.179)	(205.036)	(489.143)
Constant	241.085	762.451	2,149.769***
	(449.793)	(1,024.957)	(779.708)
Observations	98	98	98
Note:			*p<0.1; **p<0.05; ***p<0.01

	Dependent variable:		
	Creative Performance		
	(q25)	(q75)	(q95)
Word task_diff	42.821	125.742***	92.730
	(28.546)	(47.086)	(87.374)
String task_diff	-175.610***	-124.514**	15.138
	(18.568)	(52.329)	(84.605)
Found task creative	6.788	14.161	2.440
	(23.299)	(37.662)	(74.356)
Native speaker	13.779	213.882	640.090**
	(119.550)	(211.659)	(303.479)
English knowledge	88.280*	15.035	-221.346
	(50.169)	(100.625)	(172.497)
Freq. word games	-4.687	2.185	38.699***
	(26.931)	(26.890)	(0.000)
Liking word games	14.082	5.679	2.620***
	(14.913)	(14.942)	(0.000)
Risk seeking	3.246	-4.189	8.413***
	(11.028)	(13.962)	(0.000)
Extraversion	-15.210*	-4.517	-16.387***
	(8.721)	(8.580)	(0.000)
Agreeableness.R	-6.473	-7.913	−14.007***
	(8.743)	(9.500)	(0.000)
Conscientiousness	24.789**	5.585	47.155***
	(11.585)	(17.188)	(0.000)
Emotional stability.R	-6.050	-14.152	−8.541***
	(12.756)	(14.053)	(0.000)
Openness	6.330	-2.125	−6.603***
	(13.693)	(14.288)	(0.000)
Extraversion.R	−26.025**	−20.323*	−15.324***
	(10.299)	(11.287)	(0.000)
Agreeableness	-1.563	6.063	−14.122***
	(10.094)	(10.997)	(0.000)
Conscientiousness.R	15.596*	8.877	0.336***
	(8.810)	(6.815)	(0.000)
Emotional stability	0.912	4.659	1.371***
	(9.865)	(8.213)	(0.000)
Openness.R	3.523	1.615	−5.405***
	(9.180)	(9.792)	(0.000)
Gender	-10.387	-16.434	−46.879***
	(39.529)	(36.453)	(0.000)
Sequence	-4.863	-27.919	7.413***
	(26.107)	(27.806)	(0.000)
Low Constraints	-48.048	−96.151*	−118.417***
	(42.117)	(49.659)	(0.000)
High Constraints	-176.049***	−308.927***	−355.487***
	(46.125)	(48.924)	(0.000)
Constant	167.360	535.869***	605.098***
	(143.186)	(202.494)	(0.000)
Observations	98	98	98
Note:			*p<0.1; **p<0.05; ***p<0.01

4.8.9 Regressions by minutes: OLS

	Dependent variable: Routine Performance		
	(Minute 1)	(Minute 2)	(Minute 3)
Word task_diff	9.779	38.839**	13.358
	(14.084)	(16.559)	(15.889)
String task_diff	-11.716	-29.902**	-44.024***
	(11.906)	(14.020)	(13.018)
Found task creative	3.893	15.233	15.519
	(11.501)	(13.704)	(13.121)
Native speaker	71.830	88.152	42.825
	(49.626)	(58.912)	(56.226)
English knowledge	-0.462	5.807	18.583
	(15.886)	(18.881)	(17.883)
freq. word games	59.788*	19.937	68.544*
	(33.365)	(39.207)	(37.680)
liking word games	-3.983	13.213	-10.653
	(18.081)	(21.514)	(20.412)
Risk seeking	-18.422	-11.658	-14.720
	(16.000)	(18.982)	(18.217)
Extraversion	4.892	1.457	7.421
	(6.824)	(8.138)	(7.849)
Agreeableness.R	-2.517	-6.048	-8.677
	(8.183)	(9.901)	(9.618)
Conscientiousness	-7.222	8.012	7.747
	(7.862)	(9.291)	(8.912)
Emotional stability.R	-8.349	6.697	4.417
	(10.157)	(11.943)	(11.328)
Openness	4.116	8.212	9.919
	(8.238)	(9.719)	(9.344)
Extraversion.R	-10.682	-3.108	-3.432
	(8.354)	(9.937)	(9.568)
Agreeableness	7.574	5.291	-5.032
	(7.882)	(9.338)	(8.779)
Conscientiousness.R	-4.871	-5.791	0.770
	(8.383)	(9.994)	(9.630)
Emotional stability	-1.099	3.671	-1.927
	(7.706)	(9.157)	(8.508)
Openness.R	14.584	6.131	2.038
	(8.946)	(10.662)	(10.312)
Gender	22.672	-14.840	92.731*
	(47.744)	(56.707)	(53.825)
Task sequence	72.498*	-3.893	-12.638
	(39.354)	(47.988)	(45.818)
Low Constraints	-117.517**	-115.946**	-81.404
	(46.255)	(55.046)	(52.824)
High Constraints	-213.306***	-241.350***	-139.651**
	(54.644)	(65.442)	(63.266)
Constant	232.261	-75.286	100.508
	(260.488)	(307.873)	(293.346)
Observations	96	97	97
R^2	0.392	0.375	0.423
Adjusted R^2	0.209	0.189	0.252
Note:			*p<0.1; **p<0.05; ***p<0.01

	Dependent variable: Creative Performance		
	(Minute 1)	(Minute 2)	(Minute 3)
Word task_diff	-31.508**	-21.441	-21.195***
	(11.942)	(15.871)	(0.000)
String task_diff	2.538	9.555	12.271***
	(11.243)	(14.447)	(0.000)
Found task creative	-5.935	-35.819***	-22.879***
	(14.994)	(12.097)	(0.000)
Native speaker	124.136***	151.032***	165.448***
	(41.097)	(30.262)	(0.000)
English knowledge	20.943	28.936	7.845***
	(16.441)	(21.405)	(0.000)
Freq. word games	-4.315	4.042	-3.068
	(10.885)	(9.553)	(8.320)
lining word games	0.144	4.909	1.172
	(5.915)	(5.242)	(4.518)
Risk seeking	2.646	-4.858	2.974
	(5.222)	(4.625)	(4.032)
Extraversion	-1.498	-0.142	-2.226
	(2.236)	(1.983)	(1.726)
Agreeableness.R	-2.101	-1.866	-1.983
	(2.837)	(2.412)	(2.102)
Conscientiousness	6.033**	1.833	1.104
	(2.545)	(2.264)	(1.972)
emotional stability.R	-0.032	0.988	0.628
	(3.250)	(2.910)	(2.496)
Openness	3.251	1.458	2.832
	(2.673)	(2.368)	(2.062)
Extraversion.R	-0.227	-7.641***	-5.508**
	(2.729)	(2.421)	(2.110)
Agreeableness	-0.783	1.308	1.637
	(2.505)	(2.275)	(1.937)
Conscientiousness.R	-1.775	1.637	1.699
	(3.028)	(2.435)	(2.119)
emotional stability	1.194	-0.644	-0.127
	(2.439)	(2.231)	(1.880)
Openness.R	-4.383	0.331	0.418
	(2.941)	(2.598)	(2.262)
Gender	-9.777	4.285	-5.680
	(15.152)	(13.817)	(11.763)
Task sequence	-23.011*	2.450	-12.268
	(13.176)	(11.692)	(10.140)
Low Constraints	-37.761**	-13.241	-32.057***
	(15.076)	(13.412)	(11.689)
High Constraints	-87.555***	-85.401***	-98.729***
	(18.263)	(15.945)	(13.844)
Constant	112.258	176.350**	94.517
	(84.630)	(75.015)	(64.868)
Observations	95	97	98
R^2	0.522	0.628	0.647
Adjusted R^2	0.376	0.517	0.543
Note:		*p<0.1; **p<0.05; ***p<0.01	

Chapter 5

Creativity through Constraints: The Role of Domain-specific Skills

5.1 Introduction

Innovativeness and creativity are fundamental to many economic activities, and a source of advantage for firms operating in hyper-competitive markets. This increasing relevance of innovations and creativity has motivated a growing body of research to study the factors that foster creative performance, above and beyond what is known about managing routine tasks.[1] In routine tasks, a person's effort is (for the most part) directly linked to output and performance (Madjar et al., 2011). However, because of its inherent nature, the same is not true for creative tasks.

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[1]See for instance, Aghion et al. 2014, Bradler et al. 2016, Cantner et al. 2009, Charness and Grieco 2014, Crosetto 2010, Eckartz et al. 2012, Ederer and Manso 2013, Erat and Gneezy 2015. See also Brüggemann and Bizer (2016) for a review of experimental research on creativity and innovation.

Such creative tasks are often enjoyable to people and require intrinsic motivation to generate valuable output (see Amabile 1996, Deci and Ryan 1975). Monetary incentives may not always motivate task performance in a same way as they do for routine tasks (Amabile, 1996, Eckartz et al., 2012, Erat and Gneezy, 2015). While past research indicates that the performance in creative task is difficult to improve purely by monetary incentives, we provide evidence that the nature of creative process offers a novel managerial lever - the extent to which we constrain it - that has the potential to improve performance.

Traditionally, constraints have been thought to be detrimental for performance (both for creative and routine tasks). In the case of creative tasks, constraints might frame a person's thinking and not let them freely explore new ideas (see e.g. Amabile and Gitomer (1984) for early empirical study on effects of constraints on creativity).[2]

Moreover, creativity rarely has a single eureka moment when a high quality solution is found all of a sudden, and instead is an iterative process where people often improve on their own ideas. Constraining the performance by only incentivizing solutions that exceed a predetermined threshold can possibly reduce the breadth of search, and might prevent people from building-up from poorer quality solutions to better quality solutions.[3]

On the flip side, constraints can guide the creative process and prevent excessive and unproductive experimentation as has been argued by several management writers in the popular press. For instance, Sull, writing for the McKinsey Quarterly, notes that "[creators] have long recognized that constraints spur and guide innovation" (Sull, 2015). Similarly, Whitney Johnson argues that "without any constraints [creators] can easily lose [their] way" and that constraints can be "a tool of creation" (Johnson, 2013). A small body of research has recently investigated this positive effect of constraints (Burroughs and Mick, 2004, Joyce, 2009, Moreau and Dahl, 2005).[4]

[2]The question of how constraints of various types (such as resource constraints, or time constraints) affect creativity has concerned psychologists since the second half of the past century (see e.g. Amabile 1979, 1996, Crutchfield 1962, Johnson-Laird 1988, Kaufman and Sternberg 2010, Koestler 1964, Rogers 1954). While anecdotal evidence abounds for the value of constraints, most experimental studies which have examined the question has found only negative effects of constraints on performance.

[3]See for instance, Sikora (2013) and Kavadias and Sommer (2009), for a discussion of benefits of incorporating and building on other's ideas.

[4] For more arguments for constraints as enablers, see (Onarheim and Biskjaer, 2013) and (Stokes, 2005).

The current study employs a laboratory experiment to investigate the effects of incentives and performance constraints on creative outcomes. We adapt a previously used creative task in experimental economics (Eckartz et al., 2012) to explicitly manipulate the incentives and constraints, and use a survey to elicit our subjects' task-specific skill level.

The study offers a first look at when constraints have a negative effect (*preventing build-up*), and when they have positive effect (*enabling focus on high-quality solutions*). We demonstrate how the importance of each is moderated by the creators' skill level, and that performance constraints (that reward only high quality solutions) reduces the total performance of only the low-skilled creators. We provide a novel measure of creative build-up in our task, and use this measure to show that constraints disrupt build-up by low skilled individuals, and thus reduce their performance. In contrast, for the high skilled individuals, our results show that these exact same constraints *enhance* their total performance. Furthermore, our results show that performance constraints also increases the number of high quality outcomes for high skilled creators, but decrease it for low skilled creators.

Our paper contributes to theoretical understanding and helps to reconcile the two divergent perspectives on the role of constraints on creativity by demonstrating (i) the value of build-up and allowing unconstrained creation for low skilled individuals, and (ii) the value of focus and of constrained creativity for high skilled ones. Moreover, from an applied perspective, our findings are highly relevant for decision makers in innovative companies. Managers in such organizations are constantly looking for ways to design policies and mechanisms that would enhance creative output, with some firms offering employees significant leeway to do creative work.[5] Our results point toward the value of more explicit and proactive intervention, such as setting constraints for creative tasks, especially when the creators are highly-skilled at the task. More broadly, employees' skill (or knowledge) level must be a key consideration when designing the appropriate policies and mechanisms to enhance creativity.

The rest of the article is organized as follows: Section 2 discusses the relevant literature and develops our hypotheses. Details on the experimental design, procedures and treatment manipulations are provided in section 3. Section 4 reports the results, and section 5 concludes with a discussion of our research findings and its managerial implications.

[5]See for example, Schrage (2013) for a discussion of the relatively unconstrained work policies, at least for some engineers, at Google.

5.2 Theory and Hypotheses

Consistent with the viewpoint that constraints may harm creative processes, organizational management literature has argued that allowing failures (i.e., "worthless" outcomes), by allowing learning, can enhance creative productivity (see e.g. Matson 1996, Tahirsylaj 2012, Sitkin 1992). In contrast, if initial failures are penalized, people may not adequately explore the solution space. In one of the few experimental studies (that we are aware of), Ederer and Manso (2013) employ a search task and find that failure tolerance in initial phase improves the final performance (for a theoretical model, see Manso 2011).

Research at the aggregate organizational level (Tian and Wang, 2014) has also observed that when venture capital investors are willing to continue investing in under-performing ventures, and exhibit a greater tolerance for failure, then the firms backed by such investors are significantly more innovative.

We propose that the above provided argument can be reconciled with the view that constraints enhance creativity (by preventing costly and unproductive experimentation and guiding to greater focus) by considering the moderating role of domain/task relevant skills. Although the relation between domain/task relevant skills and performance is straightforward and by now well-understood,[6] it is less clear how task related skill interacts with constraints and determines creative performance.

When it comes to creative problem solving, performance constraints that push people to start off with high-quality solutions can be cognitively demanding, especially so when the person has low task relevant skills. In contrast, starting with relatively low-quality solutions allows build-up. In this way, removing performance constraints makes high-quality solutions more easily obtainable for the low skilled individuals.

On the one hand, imposing a constraint, by not rewarding low performance, does not hurt workers with high task relevant skills since they have a lesser need for build-up. Hence, performance constraints will prevent them spending time on less valuable solutions by focusing them on high quality solutions, and thus, increasing the total number of high quality solutions and the overall performance. Combining the two, we restate our novel hypotheses below:

[6] Amabile (2012, 1983) offers a componential theory of creativity, with domain relevant skills as one of the key components, and argues for its importance in driving performance. See also the meta-analysis by Liu et al. (2016).

H1: *Average performance is impacted by quality constraints.*

H1.1: *Quality constraints increase the performance for workers with high task-specific skills.*

H1.2: *Quality constraints decrease the performance for workers with low task-specific skills.*

H2: *The number of high-quality solutions is impacted by quality constraints.*

H1.1: *Quality constraints increase the number of high-quality solutions for workers with high task-specific skills.*

H1.2: *Quality constraints decrease the number of high-quality solutions for workers with low task-specific skills.*

Our main research focus is on effects of constraints and its interaction with worker's task-specific skill level elucidated above. Still, for completeness we note that with respect to the main effect of monetary incentives, consistent with the past research, we do not expect to find any significant effect (either positive or negative).

5.3 The Experimental Design

Task

The participants of the experiment worked on a word creation task, similar to the task used by Schweitzer et al. (2004) and Eckartz et al. (2012). This real effort task has the benefit of having objective measures of performance, unlike many other real effort tasks such as the alternate uses task (Guilford, 1967) or brainstorming tasks (Osborn, 1953) that rely on judges' subjective assessment of performance (Mohnen and Ostermaier, 2013). Moreover, the word creation task allows automatic scoring, which was necessary since we chose to conduct the experiment on a computer and to give the participants immediate feedback (and payments).

The task involved participants creating as many English words as they could using only a specified set of letters in 3 minutes.[7] The participants

[7]The letter set used in our study was: 'a e e i o u l n m s s r'. The total number of English words that use only this letter set is 1503. Source: http://www.wineverygame.com/

accumulate points for each word that they build, with longer words getting more points than shorter words. The actual points a subject obtains for a specific word, and the payment she receives for the total accumulated points depended on which of the 4 treatments they were assigned to.

Treatments

Our between-participant design had 4 different treatments (see Table 5.1). For our 2 (flat rate vs. piece rate) x 2 (short words allowed vs. short words disallowed) design, in the two constrained treatments, the participants were told that they will receive 15 points for words with four and more letters and zero points otherwise (for the short words); and in the two unconstrained treatments, the participants were told that they will receive 15 points for words with four and more letters and 5 points otherwise (for the short words). In the flat payment treatments, the subjects were informed that they will be paid fixed amount (USD 3) for completing the task; whereas in the piece rate treatments the subjects were told that they will be paid 1 USD for each 100 points that they accumulated by the end of the experiment.

In all treatments, subjects were told that their goal in the task was to collect as many points as possible. In addition to completing the word creation task, the subjects also completed a questionnaire designed to elicit the participant's English proficiency (as a proxy for their domain/task-specific skills). The questionnaire also collected demographic information and some additional personality traits (measured using the standard Ten Item Personality Inventory, Gosling et al. 2003). While we do not have any specific hypotheses on how these affect task performance, we had included it only for offering some preliminary exploratory analyses.

The main experiment was programmed in Python and Javascript, and was conducted on the Google Chrome browser on lab computers; and the questionnaire was programmed in widely used survey platform Qualtrics. Detailed instructions and a screen-shot of the task that the subjects saw on computer monitors are given in Appendix 5.6.2.

The experiment was conducted in a computer lab at a large US university during July-November 2016. While 244 subjects participated in the experiment, we are unable to use 26 of those because of some technical problems

Label	Incentive	Constraints	Explanation
FY	Flat rate	Yes	\$3 irrespective of final score; and 15 points for long words, 0 points for short words
FN	Flat rate	No	\$3 irrespective of final score; and 15 points for long words, 5 points for short words
PY	Piece-rate	Yes	\$1 for each 100 points; and 15 points for long words, 0 points for short words
PN	Piece-rate	No	\$1 for each 100 points; and 15 points for long words, 5 points for short words

Table 5.1: The four treatments

Incentives	Constraints	Number of Subjects	Average Payment
Flat rate	No	53	\$3.00
Flat rate	Yes	58	\$3.00
Piece rate	No	54	\$3.57
Piece rate	Yes	53	\$3.38

Table 5.2: Average payment and number of subjects

that prevented the data from being recorded.[8] This left us with 218 usable observations. Table 5.2 shows the number of participants and their average payments in each of the 4 conditions.[9] The experiment lasted approximately 30 minutes and the participants were undergraduate students of whom 66% were females.

All the statistical analysis were conducted using R (R Core Team, 2013). Next, we report our results.

5.4 Results

Figure 5.1 illustrates and Table 5.3 reports the results of a linear regression with subjects' total accumulated scores as the dependent variable and the main treatments and their interaction (Incentives and Constraints) as the independent variables. Consistent with the past literature that finds limited value of incentives for improving the performance in creative tasks, our results show that piece rate incentives do not significantly change the performance relative to flat payments (344.0 for **FN** vs 356.6 for **PN**, t(214)=-0.30, p=0.7; and 283.7 for **FY** vs 338.2 for **PY**, t(214)=-1.36, p=0.17). Moreover, constraints by themselves do not significantly change the performance (344.0 for **FN** vs 283.7 for **FY**, t(214)=1.50, p=0.13; and 356.6 for **PN** vs 338.2 for **PY**, t(214)=0.45, p=0.65).

While our results indicate that incentives and constraints do not influence performance on the word building task (at least on average), incentives and constraints are not without any effect on how our subjects go about completing the task. Specifically, if we look at the total number of words (including those receiving a zero score) that are created by our subjects, we see that piece rate incentives increase the number of words (33.3 vs 29.1, t(215)=1.78, p=0.07), and constraints decrease them (28.5 vs 33.9, t(215)=-2.26, p=0.02). Table 5.4 reports the results of a regression with total number of words submitted as the dependent variable.

[8] A massive DDoS attack made much of the web, including Qualtrics, inaccessible from the university computers during part of a day. On another separate day, a technical problem with Qualtrics data center made part of the experiment unavailable.

[9] All the results tables were automatically generated from the data using stargazer R package (Hlavac, 2014).

Table 5.3: Effect of incentives and constraints on performance

	Dependent variable:	
	Creative Performance	
	(1)	(2)
$1_{\{\text{piece rate}\}}$	16.94	16.75
	(14.28)	(14.30)
$1_{\{\text{constraints}\}}$	-19.86	-19.68
	(14.28)	(14.30)
$1_{\{\text{piece rate and constraints}\}}$		10.50
		(14.30)
constant	330.35***	330.64***
	(14.28)	(14.30)
Observations	218	218
R^2	0.02	0.02
Adjusted R^2	0.01	0.004
Residual Std. Error	210.71 (df = 215)	210.94 (df = 214)
F Statistic	1.72 (df = 2; 215)	1.32 (df = 3; 214)
Note:		*p<0.1; **p<0.05; ***p<0.01

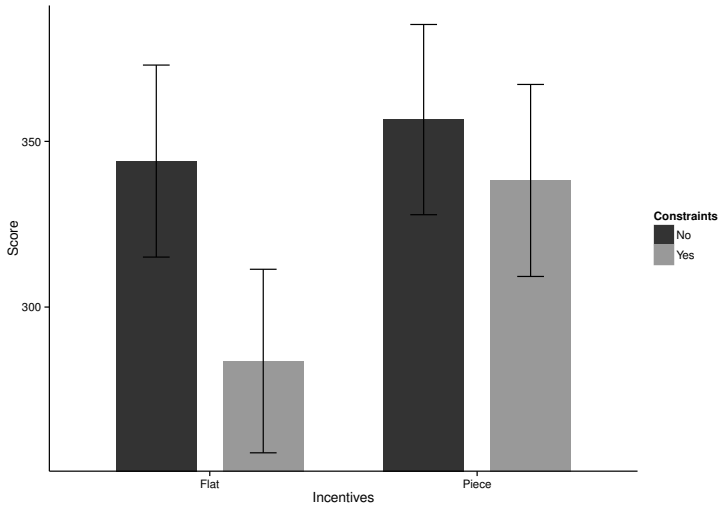

Figure 5.1: Performance in the 4 conditions

Table 5.4: Effect of incentives and constraints on number of words (including those receiving 0 points)

	Dependent variable:	
	Number of words	
	(1)	(2)
$1_{\{\text{piece rate}\}}$	2.10*	2.09*
	(1.18)	(1.18)
$1_{\{\text{constraints}\}}$	-2.68**	-2.66**
	(1.18)	(1.18)
$1_{\{\text{piece rate and constraints}\}}$		0.64
		(1.18)
constant	31.20***	31.22***
	(1.18)	(1.18)
Observations	218	218
R^2	0.04	0.04
Adjusted R^2	0.03	0.03
Residual Std. Error	17.43 (df = 215)	17.46 (df = 214)
F Statistic	4.26** (df = 2; 215)	2.93** (df = 3; 214)
Note:		*p<0.1; **p<0.05; ***p<0.01

Thus, it appears that while incentives motivate the subjects to work harder (by submitting more words), performance on the word creation task, similar to many other creativity tasks studied in the past literature, seems to be relatively insensitive to motivation and effort. Moreover, our results show that constraints change the way people work (by reducing the number of words they submit), but the performance is not significantly impacted. We summarize the results about incentives and constraints before proceeding to analysing the role of domain/task-specific skill.

Result1: Piece rate incentives, while increasing the number of submissions, do not improve performance relative to flat payment.

Result2: Constraints, while decreasing the number of submissions, do not significantly impact performance.

Descriptive statistics about our subjects' assessment about English language proficiency, which we use as a proxy for their skill, is reported in Appendix 5.6.3. While we expect English language proficiency to be a stable characteristic, especially given that the 7 point scale asks about general English knowledge and not about the task ("How well do you speak, read and write in English language?"), we conducted a one-way Anova to ensure that English proficiency was on average equal across our treatments (F-value=0.09, p=0.96). Thus, the particular treatments do not affect self-reported proficiency (see also Table 5.8 in Appendix).[10]

Table 5.5 reports the results of a linear regression with subject's score as the dependent variable, and the subject's skill along with the main treatments as the independent variables. The interaction of skill with constraints is significant. To more easily interpret the results, we split the skill as High or Low based on whether it is above or below the median skill and created the plot (for piece-rate incentives) shown in Figure 5.2. High skilled subjects perform better with constraints compared to without constraints (514 vs 330, t(210)=2.48, p=0.01). Low skilled subjects perform worse with constraints compared to without constraints (268 vs 367, t(210)=98.9, p=0.03). We state this result below before proceeding to examine it in more detail.

Result3: Under piece rate incentives, constraints decrease performance for

[10] A second, and perhaps less important, concern might be that (perception of) skill level itself might be driven by the performance. However, note that this would predict an association between skill and performance and not the interaction between skill and constraint that is our main hypothesis.

Table 5.5: Interaction of skill with constraints

	Dependent variable:	
	Creative Performance	
	(1)	(2)
$1_{\{\text{piece rate}\}}$	16.88	-91.12
	(13.78)	(83.51)
$1_{\{\text{constraints}\}}$	-20.35	-168.77**
	(13.78)	(82.82)
Skill	57.87***	61.79***
	(13.92)	(13.98)
$1_{\{\text{piece rate and constraints}\}}$	8.52	8.23
	(13.79)	(13.70)
Skill $\times 1_{\{\text{piece rate}\}}$		18.16
		(13.96)
Skill $\times 1_{\{\text{constraints}\}}$		25.04*
		(13.84)
constant	-10.76	-34.15
	(83.25)	(83.63)
Observations	218	218
R^2	0.09	0.11
Adjusted R^2	0.07	0.09
Residual Std. Error	203.34 (df = 213)	201.96 (df = 211)
F Statistic	5.39*** (df = 4; 213)	4.46*** (df = 6; 211)

Note: *p<0.1; **p<0.05; ***p<0.01

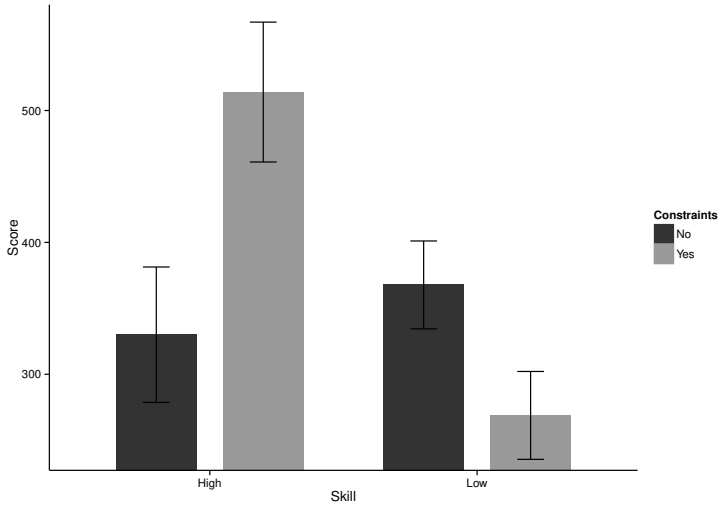

Figure 5.2: Interaction of constraints with skill (in piece-rate treatment)
Low/High skill plotted by splitting at the median skill level

low skilled subjects while constraints increase performance for high skilled subjects.

To understand the interesting interaction of skill with constraints, it is useful to also examine the exact number and type of words that are created in the constrained conditions by low- and high-skilled subjects.

Unsurprisingly, since short words are worth 0 points in the constrained condition, we find that both low- and high-skilled subjects make fewer of those words when they are constrained compared to when they are not (0.0 vs 5.13 for high-ability, $p<0.001$; and 0.0 vs 5.12 for low-ability, $p<0.001$). But case of longer words is drastically different. Figure 5.3 illustrates and Table 5.6 reports the results of a linear regression with dependent variables as the number of long words (≥ 4 letters) that the subject created, and the subject's skill along with the main treatments as independent variables.

High skilled subjects create more long words with constraints compared to without constraints (34.2 vs 20.3, $t(210)=2.83$, $p<0.01$). Low skilled subjects create fewer long words with constraints compared to without constraints (17.9 vs 22.9, $t(210)=1.61$, $p=0.10$). We summarize these below before exploring the underlying mechanism in some more detail.

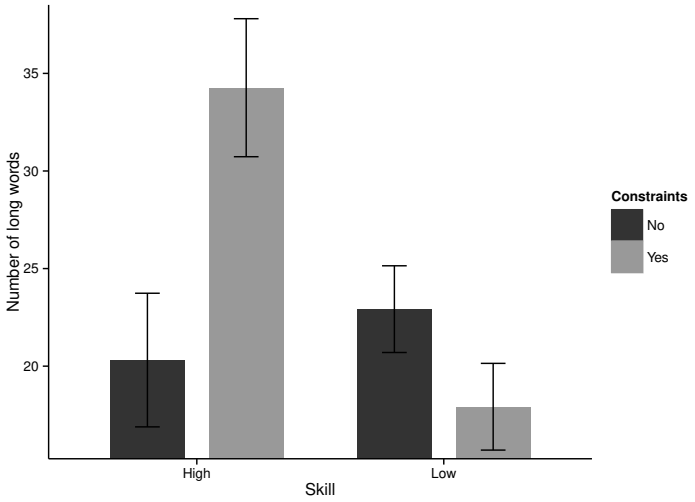

Figure 5.3: Average number of long words (in piece rate conditions)

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Low/High skill plotted by splitting at the median skill level

Table 5.6: Effect of constraints and skill on number of long words (for piece-rate conditions)

	Dependent variable:	
	Number of Long Words	
	(1)	(2)
$1_{\{\text{constraints}\}}$	-0.04	-14.82*
	(1.35)	(8.61)
Skill	5.21***	5.38***
	(1.45)	(1.44)
Skill $\times 1_{\{\text{constraints}\}}$		2.51*
		(1.44)
constant	-8.40	-9.48
	(8.67)	(8.61)
Observations	107	107
R^2	0.11	0.14
Adjusted R^2	0.09	0.11
Residual Std. Error	13.90 (df = 104)	13.77 (df = 103)
F Statistic	6.46*** (df = 2; 104)	5.40*** (df = 3; 103)
Note:		*p<0.1; **p<0.05; ***p<0.01

Result4: In piece rate treatment, constraints decrease the number of long words for low skill subjects, while constraints increase the number of long words for high skill subjects.

Our results show that, for high-skilled subjects, constraints helped by preventing them from making shorter words and instead forcing them focus more on generating longer (and more valuable) words. This is especially interesting since there is nothing preventing these subjects from generating longer words (even in the unconstrained condition) and obtaining greater overall score; but without the constraint, our high-ability subjects fail to emphasize creating longer words and focus instead on the shorter (possibly easier to construct) words at the cost of losing out on the final score.

In the case of low-skilled subjects, constraints prevent them from making short words and long words. This result is consistent with the view that novel or complex solutions require gradual build-up, and constraints which prevent such build-up will be detrimental to final performance.

The above set of results give indirect evidence for build-up, especially for low skilled people. However, our data also yields much more direct evidence. Specifically, our subjects create words sequentially (over a period of 3 minutes) allowing us to measure similarity between a word and words that came before it. And to the extent that a long word is preceded by "similar" words, we can view it as build-up occurring.

We measure the normalized similarity of two words as follows: we calculate the longest common substring (i.e., the longest string that can be obtained by pairing characters from the two words while keeping the order of characters intact). The normalized distance between the two words is the number of unpaired characters divided by the sum of word lengths (see van der Loo 2014 for details on the algorithm for calculating the distances). The normalized similarity, which is our measure of build-up, is 1 minus this normalized distance.[11]

With this measure of build-up, we examined how the average build-up for a given subject is related to his skill. Table 5.7 reports and Figure 5.4 illustrates these results. As may be observed, the subjects with high skill levels exhibit significantly less build-up compared to subjects with low skill level. Thus, it

[11] As an example, consider the two words "SLATE" and "ATE". The distance substring "ATE" is common, and the number of unpaired characters is 2 (namely, S and L). Thus, the normalized distance is $\frac{2}{5+3}$ and the normalized similarity is $1 - \frac{2}{5+3} = 0.75$.

Table 5.7: Buildup of words among subjects (in unconstrained condition)

	Dependent variable:	
	Buildup (word similarity)	
	(1)	(2)
^{1}\{piece rate\}	-0.01	-0.01
	(0.01)	(0.01)
Skill	-0.02**	-0.02**
	(0.01)	(0.01)
Number of words		0.0001
		(0.0005)
constant	0.51***	0.51***
	(0.05)	(0.05)
Observations	107	107
R^2	0.06	0.06
Adjusted R^2	0.04	0.03
Residual Std. Error	0.08 (df = 104)	0.08 (df = 103)
F Statistic	3.38** (df = 2; 104)	2.25* (df = 3; 103)
Note:		*p<0.1; **p<0.05; ***p<0.01

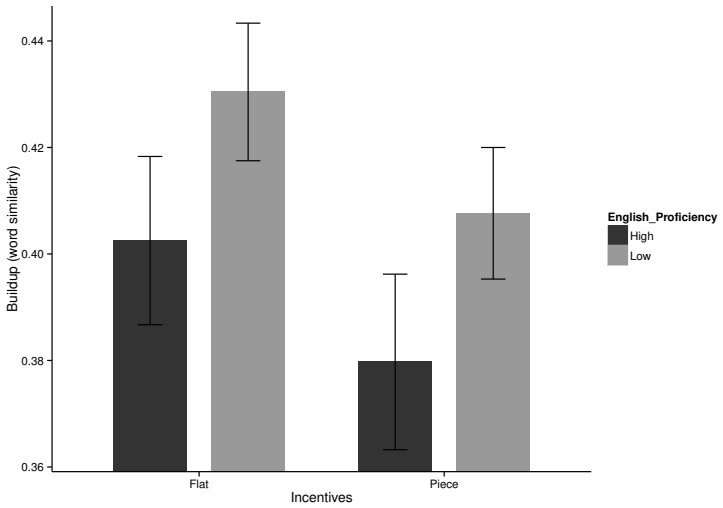

Figure 5.4: Buildup of words (in unconstrained conditions)

appears that high skilled subjects do not need (and do not use) build-up as much as low skilled subjects. Consequently, when working under performance constraints, it is the low skilled subjects' creative production that becomes disrupted. We state this result below.

Result5: Low-skilled subjects engage in significantly more build-up compared to high-skilled subjects.

Before proceeding to discuss the implications of our key results, we briefly make a note of some additional analysis of other control variables and personality traits that we conducted. While exploratory, it was interesting that in these regression results (see Appendix 5.6.4 for the full set of results), of the BIG FIVE personality traits - emotional stability was positively related to performance and reversed measure for openness was negatively linked to the performance; and we failed to find any significant gender differences in performance.

5.5 Discussions and Conclusion

Creativity is key to competitive advantage. In this article we examine how performance constraints that incentivize only high quality solutions affect the creative outcomes, and how the effect of constraints depends on the creator's domain relevant skill level. In line with the previous literature, we find that piece-rate incentives by themselves, while useful for enhancing motivation and effort levels (and number of solutions), fail to improve overall performance. Thus, traditional incentives that have been found to be useful in improving performance in routine tasks prove unsuccessful in improving performance in our creative task as well.

More importantly, our results reconcile two different views on constraints for creative tasks. By analysing interaction of performance constraints with creator's domain relevant skills we demonstrate that constraints can help or hurt the overall creative performance (and even the number of high-quality solutions) depending on the creator's skill level. Our findings suggest that, constraints push high skilled individuals to direct their effort to part of the solution space with higher value, and improve overall performance.

It is interesting to note that in a rational model, a creator should be able to perform at least as well without constraints as with constraints, since she can

always act "as if" there are constraints even when the setting is unconstrained. However, our results show that without constraints, high-skill creators fail to focus on high-quality solutions and instead produce (easier?) low-quality solutions. Thus, constraints focus our high-skilled creators on more valuable solutions. Moreover, by improving the overall performance of solutions and the pay-offs of the high-skilled creator, constraints end up being pareto improving for both the firm and for the creative workers. This is not the case for low skilled individuals. With lower skilled creators, imposing constraints reduces both the overall performance and the number of high-quality solutions.

The current article offered a novel measure of build-up and the first direct evidence in a real-effort task (that we are aware of) that shows build-up in problem solving, and its dependence on the subject's skill level. In addition to its theoretical contribution, from the managerial perspective, understanding the creative process and managing build-up where people gradually improve their solutions/inventions is a requirement for innovative organizations.

The current research, using a measure of build-up in a controlled laboratory experiment, demonstrates that constraints, at least for the low-skilled creators, impede the natural build-up from less valuable solutions to more valuable solutions. In contrast, our results show that high-skilled creators do not need or use build-up, and consequently do not suffer from constraints. In fact, for these individuals, our results show that constraints focus their work, prevent unproductive low-quality solutions, and guide them towards higher performance.

Our findings have several managerial implications: Firstly, offering incentives for creative workers seems to have very little effect on overall performance. Still, when managing employees who are highly skilled at the creative task, setting performance constraints (or minimum quality requirements) can prove valuable in providing guidance, focusing attention on the better parts of the solution space, and improving both the number and overall value of high-quality outcomes. However, when the workers are less skilled at the task, performance constraint impedes initial exploration and build-up towards better solutions. In such a case, the managers are better served by not having performance constraints and incentivizng even the less valuable solutions. Table below summarizes these implications.

	Constrained	Unconstrained
Low skills	Buildup disrupted Few high-quality solutions	Buildup feasible More high-quality solutions
High skills	Focused creative process More high-quality solutions	Unproductive creation Few high-quality solutions

Our study was intended to give a first look at the interaction of creator skills with an important feature of creative process, namely the performance constraints. It would be useful for future research to study if other performance pressures (such as presence of competition, or strict time pressures) interact with creator skills in determining performance. Second, in contexts where skill level itself can be manipulated (perhaps by interventions such as training, or practice), it would be useful to understand how managers can effectively choose between enhancing skill levels and setting more ambitious goals, or allowing lower-skilled workers to work with fewer constraints.

5.6 Appendix

5.6.1 Instructions

General Instructions

Welcome and thank you for participating! All the answers you provide are confidential.

In this experimental session, you will be asked to participate in an experimental study, for which you will receive $5 participation fee. In addition to this participation fee, you will also receive any money you earn in the study.

Please make sure that you read the instructions on the next pages carefully to avoid any misunderstanding and to earn the most money. The study is expected to take less than 10 minutes to complete.

Please, click below when you are ready to proceed to the study.

5.6.2 Word task instructions

Word Task

Please read the instructions carefully before starting on the current task. Depending on your answers, you will receive points.

And for every 100 points that you obtain by the end of the task, you will receive $1.

In this task you will be given 3 minutes to come up with as many words as you can that use only a specific set of letters.

Longer words receive more points compared to shorter words.

Note that only the words that we identify as coming from a commonly used English language dictionary will be awarded points.

The actual set of letters you have to work with, and the points you receive for different words lengths are given on the next page.

Before clicking below to proceed, please read the full set of rules below.

- You may use only the letters in the set that we give you. For instance, if the set of letters we gave you is A, E, E, L, B then words
  - word ALE is allowed (since the set has the letters A, L, and E);
  - the word BELL is not allowed (since the word has two Ls and the set only has one L);
  - the word EEL is allowed (since the word and the set both have two Es).
- With the letters we provide, you may build small words or large words.
- Just repeatedly building the same words will not get any additional points.

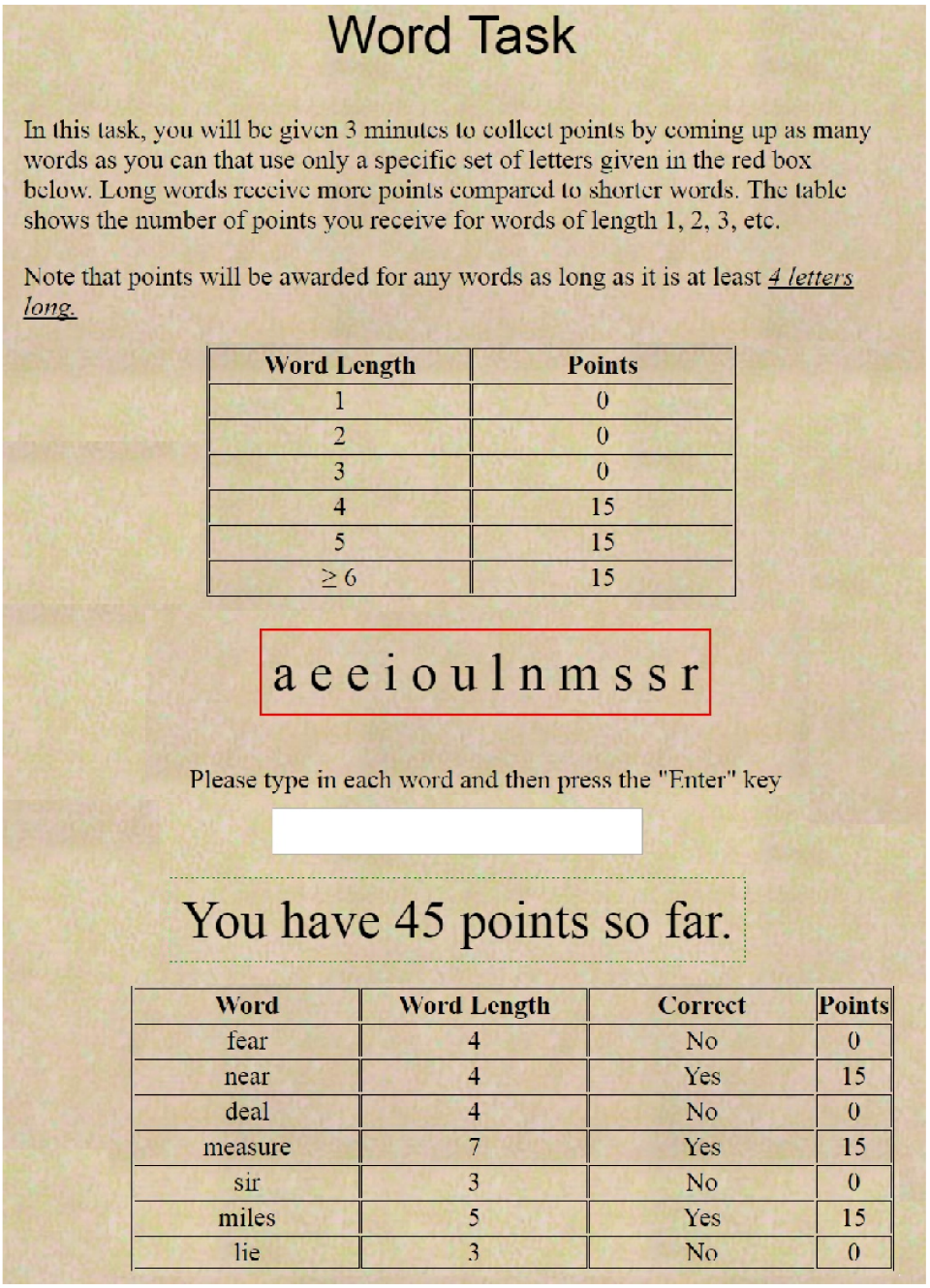

Figure 5.5: Screenshot of word task

5.6.3 Descriptive Statistics: Subjects' Performance and Skill Levels

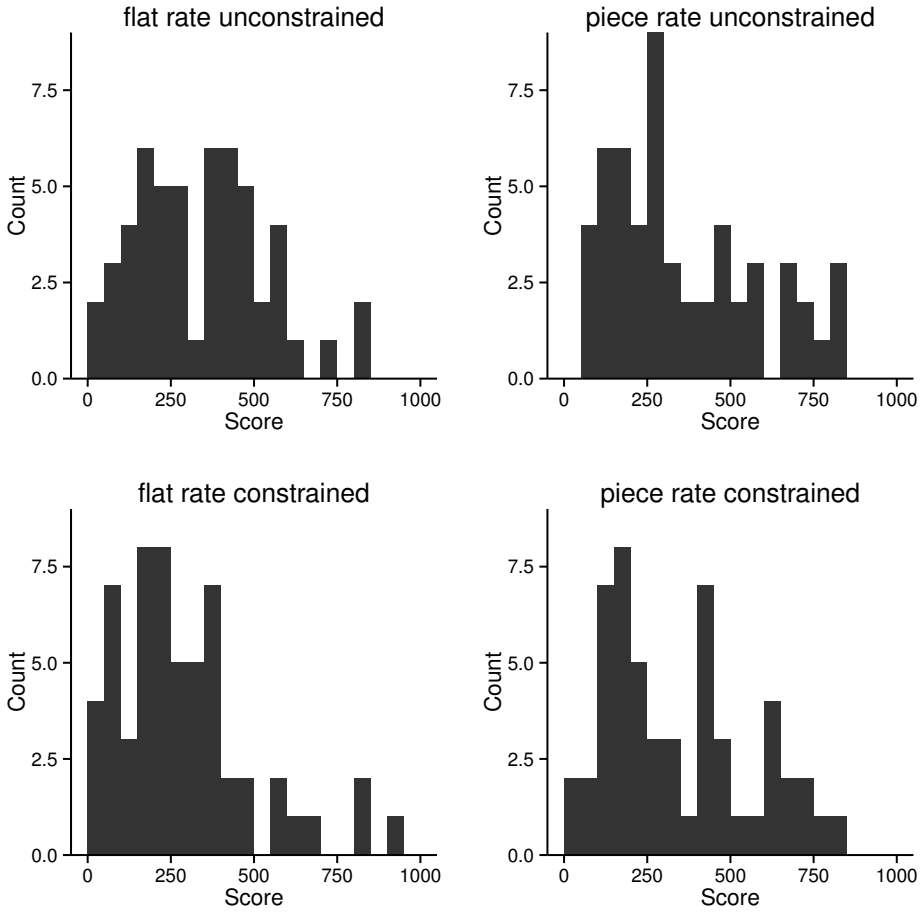

Figure 5.6: Distribution of score for the 4 treatments.

	Mean Eng. Prof.	**Median Eng. Prof.**
Flat constrained	5.88	6
Flat unconstrained	5.92	6
Piece constrained	5.85	6
Piece unconstrained	5.94	6

Table 5.8: English proficiency in each treatment

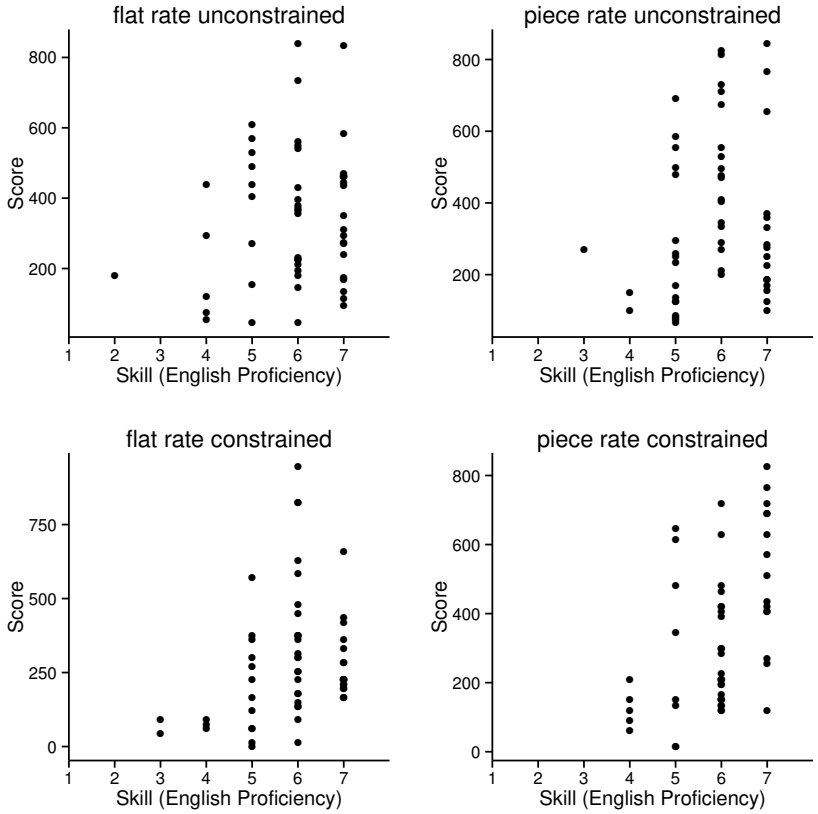

Figure 5.7: Performance of participants and their English proficiency across treatments

5.6.4 Effect of Other Covariates

	Dependent variable:	
	Creative Performance	
	OLS	*Tobit*
Found task difficult	-47.243***	-48.263***
	(10.653)	(10.181)
Found task creative	-4.339	-4.774
	(8.984)	(8.567)
Native speaker	146.534***	144.488***
	(25.691)	(24.530)
Freq. word games	70.984***	70.921***
	(15.505)	(14.774)
Liking word games	11.327	12.345
	(10.188)	(9.739)
Risk seeking	3.919	4.346
	(8.660)	(8.258)
Extraversion	6.303	6.900
	(6.788)	(6.484)
Agreeableness.R	-4.052	-4.606
	(6.741)	(6.437)
Conscientiousness	3.568	4.012
	(6.836)	(6.523)
Emotional stability.R	-0.070	0.019
	(6.798)	(6.477)
Openness	8.920	8.682
	(7.919)	(7.548)
Extraversion.R	-6.553	-5.969
	(6.435)	(6.148)
Agreeableness	-4.649	-5.226
	(7.306)	(6.975)
Conscientiousness.R	-11.172	-10.803*
	(6.852)	(6.535)
Emotional stability	21.604***	21.979***
	(6.472)	(6.174)
Openness.R	20.540***	20.806***
	(6.901)	(6.579)
Gender	-12.504	-11.729
	(23.622)	(22.516)
Constrained flat rate	-42.060	-44.477
	(30.373)	(29.001)
Piece rate	18.871	18.625
	(30.993)	(29.532)
Constrained piece rate	16.259	16.143
	(31.375)	(29.896)
Constant	79.273	74.394
	(124.977)	(119.143)
Observations	218	218
R^2	0.507	
Adjusted R^2	0.457	
Log Likelihood		-1,393.590
Residual Std. Error	155.775 (df = 197)	
F Statistic	10.133*** (df = 20; 197)	
Wald Test		224.906*** (df = 20)
Note:		*p<0.1; **p<0.05; ***p<0.01

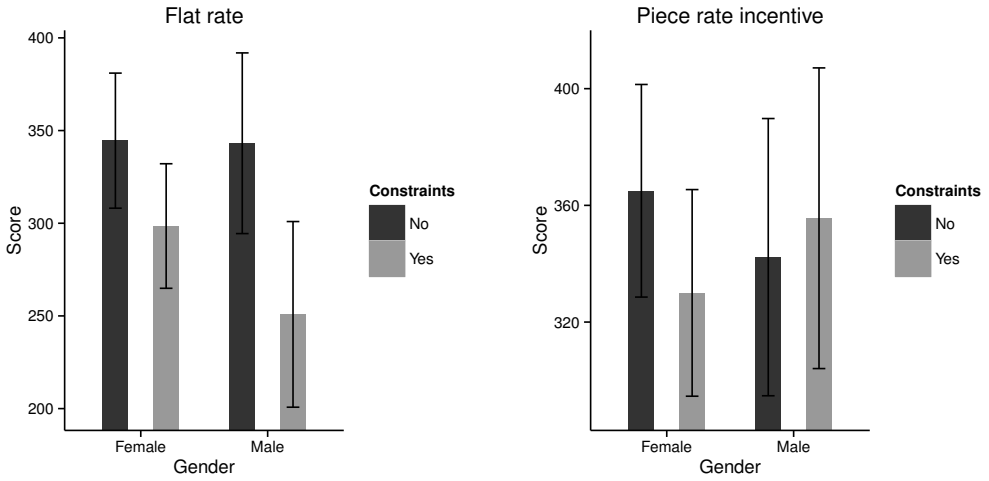

Figure 5.8: Average score by gender

5.6.5 Average Length of Correct Solutions

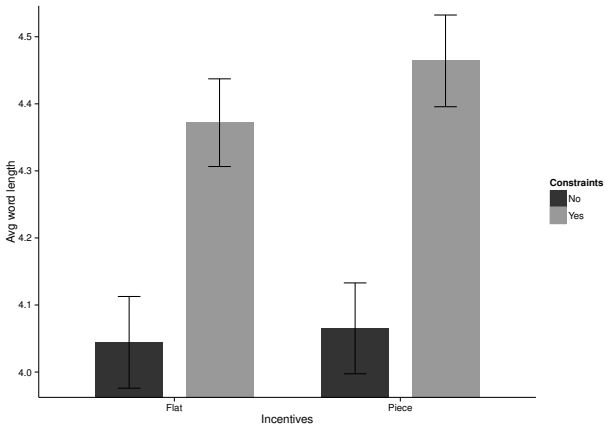

Figure 5.9: Average word length (only words which got a non-zero scores are counted)

Chapter 6

Conclusion

6.1 Main Contributions

This thesis contributes to the economic literature on creativity. I apply experimental methodology to study behaviour while and after performing routine and creative tasks. Specifically, I investigate cooperation levels after completion of tasks and more importantly, performance on tasks under various payment schemes. I also examine the interaction of domain specific skills with constraints and their effect on creative output. Thus, the main findings of this work relate to:

- Cooperation after exerting creative and routine efforts.
- Competitive incentives for creative and routine performance.
- Constraints for creative and routine performance.
- Role of domain-specific skills for creative performance under constraints.

6.1.1 Cooperation

Rapid advance in technological innovations increased demand for creative jobs. In modern companies groups of creators often share their competences and experiences to benefit from each other and improve general knowledge base.

These individuals gain their skills from different types and levels of effort. Some behavioural scholars showed that depending on the size of effort people exert, they may become more self-oriented and hesitant to share their endowments. This kind of inclination could have substantial adverse consequences if group members shape their cooperative behaviour depending on their effort exerted in unrelated situations.

In chapter 2 I experimentally study whether effort levels and effort types change cooperation decisions. The results show that the amount of effort and the type of effort that people exert, do not change average cooperativeness in small groups. Regardless of the source of endowments, people cooperate depending on their personality characteristics.

6.1.2 Competition

Designing an optimal reward mechanism in organizations has been studied since long. Managers often have a fixed budget to remunerate employees. In such conditions it is crucial to come up with an optimal reward system to achieve the highest productivity with given limitations. While for routine tasks monetary incentives usually increase routine performance, this is rarely the case for creative tasks. Similarly, in contrast to routine tasks, creative tasks are usually not motivated by competitive incentives.

In chapter 3 I report on a study which investigates different degrees of competition and corresponding effects on routine and creative performance. In line with the previous literature, the findings suggest that low competition improves routine, but not creative performance. However, high competition is not supportive for average performance on both types of tasks. Moreover, provision of feedback before the completion of the task has a negative effect on creative performance.

6.1.3 Constraints

In companies employees often have to fulfil certain criteria to make their work acceptable. In other words, principals usually want their employees to meet predetermined standards, because other types of solutions may be worthless. Under such circumstances, managers may want to impose quality constraints. Although it seems rational to reward only those type of solutions which are

valuable, a large body of research argues against constraints especially for creative tasks. The traditional view on creative thinking is that it should not be restricted or framed. Creators need freedom to explore new ideas without external interference. However, recent theoretical contributions to the literature and anecdotal evidence from popular press suggest that constraints in fact may provide guidance for creators and can even motivate them by making their task more challenging.

In the fourth chapter I study the effects of low and high constraints for routine and creative tasks. In support of a conventional view on constraints, I find that routine as well as creative performance decrease even when low constraints are imposed. Further analysis shows that after the initial phase, creators adapt to the constraints and perform as well as unconstrained individuals. More interestingly, looking at overall performance, unconstrained creators produce more high-quality solutions than the constrained ones, although the latter are asked to produce only high quality solutions. This indicates on possible build-up of creative solutions when the creators are not constrained.

6.1.4 Domain-specific Skills

The fact that a domain-specific or task relevant skill is helpful for creative performance is well documented. However, it has not yet been analysed how constraints and the skills interact when a creative task has to be done. In general there are opposing views on how constraints affect creative output. On the one hand constraints may have a negative effect, restricting formation and the development of novel ideas. On the other hand constraints may guide creators to focus their attention on a more valuable solution space.

In the fifth chapter I research the role of a domain specific skill for creative performance under constraints. The results show that constraints enhance creative performance of highly competent creators. However, the same constraints decrease performance of less competent individuals. The main reason is that low skilled creative workers build on their own creations. They gradually improve complexity of their solutions to achieve higher standards and the constraints disrupt this build-up. In contrast, high skilled workers do not use build-up, since they are able to easily overcome the hurdle provided by the constraints.

6.2 Policy implications

The research findings of this thesis provide several policy implications. Firstly, the results of the second chapter imply that cooperation in small groups is not affected by the effort type (routine or creative) and effort levels that the group members exerted to acquire their endowments. Individuals are rather influenced by their personality characteristics when cooperating in a group. Therefore, company authorities should focus on individual traits and experiences, for example, whether a job candidate has previous experience in working groups or not and how pro-social she is.

The third chapter offers some implications on whether and how a management should use competitive incentives. Since effort and performance for routine tasks are closely linked, organisation leaders can use low competitive incentives to improve routine performance. However, high competition is not conducive to routine performance. Applying any competitive incentive is not supportive for creative performance. Moreover, if designing a competitive incentive for creative tasks, managers should avoid provision of performance feedback until completion of the task.

The research results of the fourth chapter suggest that constraints are detrimental for routine and creative tasks. However, it can be the case that a management can not accept low quality creative solutions. Under such circumstances principals should expect that it will take some time before employees adapt to low constraints and perform as well as in unconstrained condition. The significant decrease in creative performance even in low constraint conditions are caused by disruption of build-up, that is gradual progress towards highly creative solutions.

Lastly, whether the constraints for creative performance have a negative or positive effect depends on creative workers' task-related skill levels. A management can use constraints to guide high skilled employees to focus on more valuable creative solutions. However, for low skilled workers, quality constraints should not be used. For them it is more beneficial to reward low quality solutions (that can be regarded as tolerating initial failure) to enable achieving of higher creative potential.

6.3 Future Research

While the current thesis filled research gaps in creativity research in economics, much more work has to be done. First of all, laboratory experiments have limited external validity, therefore the results have to be replicated and possibly also be tested in the field. For example, the findings of the second chapter suggest that the source of an endowment does not determine cooperation levels. However, it can be the case that effort manipulation in a short laboratory experiment is not sufficient for the emergence of a creativity effect. Therefore, longer experiments, ideally with different tasks and real creators, have to be designed.

Competitive incentives and provision of feedback is a complex topic. While the research results from the third chapter provide new insights, it was impossible to cover all possible treatment variations in a single study. For instance, it would be a valuable contribution to the literature to study how feedback affects low competitive incentives for routine and creative tasks. The chapter analysed a winner-take-all tournament. Other modifications of tournaments should also be researched. Moreover, in this chapter feedback on ranking and the best performance was provided before the completion of the task. Future research should also apply other types of tournaments (such as rank-order tournaments) and manipulate various contents of the feedback, like showing a performance of not only the leading competitor but all the competitors.

Effects of constraints on creative and innovative tasks are not well researched in economics. While in this thesis I provide new perspectives on when constraints could be beneficial, there are much more interesting aspects to explore. For example, in contexts where a skill level itself can be manipulated (perhaps by interventions such as training or practice), it would be useful to understand how managers can effectively choose between enhancing skill levels and setting more ambitious goals or allowing lower-skilled workers to work with fewer constraints. It would also be useful for future research to study whether other performance pressures (such as presence of competition, or strict time pressures) interact with creator skills in determining performance.

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Current Position

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